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43D CONGRESS, } HOUSE OF REPRESENTATIVES. { REPORT
1st Session. } { No. 259.

CULTIVATION OF TIMBER AND THE PRESERVATION OF FORESTS.

MARCH 17, 1874.—Recommitted to the Committee on the Public Lands and ordered to be printed.

Mr. DUNNELL, from the Committee on the Public Lands, submitted the following

REPORT:

[To accompany bill H. R. 2497.]

The Committee on the Public Lands, to whom was referred the special message of the President of the United States communicating information in relation to the cultivation of timber and the preservation of forests, together with a communication from the Commissioner of the General Land-Office upon the same subject, would respectfully report:

That they have given their attention to the subject, and learn that the memorial above referred to was prepared by a committee appointed by the American Association for the Advancement of Science, as the result of a discussion induced by a communication read before them at their annual session in Portland, Me., on the 21st day of August, 1873, "On the duty of governments in the preservation of forests."

A subject indorsed by an association embracing within its membership the highest scientific talent of the country commends itself to our notice as worthy of attention. More especially is this notice due, when their action takes the form of a recommendation to Congress upon a subject alleged to involve the duty of the Government upon questions that vitally affect the interests of the whole country, and especially those of agriculture, manufactures, and commerce. When it is further affirmed that, without timely provision by law, these great agencies of civilization and elements of wealth will, in the near future, be materially impaired, we cannot hesitate to give these recommendations a most careful examination, to the end that, if well founded, the measures best calculated for averting these injuries may be devised, and the remedies most effectually applied.

After as full an investigation of this question as present opportunities allow, we are convinced that the statements of the memorial are essentially true, and that it is the duty of the Government to take immediate measures for ascertaining the condition and prospects of our timber-supply, to the end that the future wants of the country with regard to these great interests, both in their scientific and practical relations, should be thoroughly investigated and made widely known.

In European countries, large forests are owned and managed by governments, and elaborate systems of culture have been devised. With us, the greater part of the lands in the older States have already passed into the hands of private owners, and much that remains in the newer States and in the Territories is without timber. The operations of planting and management must, therefore, be left to private enterprise. We do not now recommend the undertaking of this industry by the Government, nor can we foresee that such a measure could ever in future be attempted beyond the reservation of such valuable timber-tracts as remain in our public domains, and that may seem to require preservation against injury or depredation.

But, in the great questions of forest-economy which we see arising, and concerning which our people have everything to learn, we realize the need of every aid to practical success that the experience of older nations in Europe has wrought out, and all the benefits that science can confer, in rendering success in forest-culture and timber-economies certain and complete.

There is no way in which this can so effectually be done, as by the employment of a man thoroughly competent for the duty, who might be able to bring to his subject the fruits of ripe experience in statistical inquiries and scientific labor, and collect, classify, condense, and make available whatever knowledge there may be found appertaining to the general object. And being deeply impressed with the great importance to the whole country of such a measure of economy and utility, and of the necessity for early action, your committee recommend the accompanying bill, H. R. No. 2497, "A bill for the appointment of a commission to inquire into the destruction of forests, and into the measures necessary for the preservation of timber."

We also adopt and make a part of this report the letter of Dr. Franklin B. Hough, chairman of committee of American Association for the Advancement of Science, upon the subject of forestry, and his very able and scientific analysis of the subject of forestry, made an appendix hereto.

MARK H. DUNNELL,
WM. A. PHILLIPS,
W. S. HERNDON,
Subcommittee.

A BILL for the appointment of a commission for inquiry into the destruction of forests and into the measures necessary for the preservation of timber.

Whereas it is asserted that the supply of timber within the United States is rapidly diminishing, and that great public injury must result from its continued waste, unless adequate means are taken for its preservation and production: Therefore,

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the President be, and he is hereby, authorized and required to appoint, by and with the advice and consent of the Senate, a man of approved scientific attainments, who is practically well acquainted with methods of statistical inquiry, and who has evinced an intimate acquaintance with questions relating to the national wants in regard to timber, and with the measures that may be best calculated to meet these wants, as they arise, to be Commissioner of Forestry.

SEC. 2. That it shall be the duty of said Commissioner, under the direction of the Secretary of the Interior, to prosecute investigations and inquiries, with the view of ascertaining the annual amount of consumption, importation, and exportation of timber and other forest-products, the probable supply for future wants, the means best adapted to their preservation and renewal, the influence of forests upon climate, and the measures that have been successfully applied in foreign countries, or that may be deemed applicable in this country, for the preservation and restoration or planting of forests, and to report upon the same to the Secretary of the Interior, to be by him transmitted to Congress.

SEC. 3. That the heads of the Executive Departments be, and they are hereby, directed to cause to be rendered all necessary and practical aid to the said Commissioner, by access to the public records and otherwise, in the prosecution of the investigations and inquiries aforesaid.

Message from the President of the United States, communicating information in relation to the cultivation of timber and the preservation of forests.[*]

EXECUTIVE MANSION,
February 19, 1874.

To the Senate and House of Representatives:

I have the honor to transmit herewith a memorial upon the cultivation of timber and the preservation of forests, and a draught of a joint resolution prepared by the American Association for the Advancement of Science, together with a communication from the Commissioner of the General Land-Office upon the same subject.

U. S. GRANT.

DEPARTMENT OF THE INTERIOR,
Washington, D. C., February 18, 1874.

SIR: I have the honor to transmit herewith a memorial from the American Association for the Advancement of Science, upon the cultivation of timber and the preservation of forests, together with a draught of a joint resolution prepared by the memorialists.[†]

These papers were referred to the Commissioner of the General Land-Office, and a copy of his report on the subject is herewith inclosed. Concurring in his views, I would repectfully suggest the propriety of laying the matter before Congress for their consideration.

Very respectfully,

C. DELANO,
Secretary.

The PRESIDENT.

DEPARTMENT OF THE INTERIOR,
GENERAL LAND-OFFICE,
Washington, D. C., February 17, 1874.

SIR: I have the honor to acknowledge the receipt, by reference, of a memorial from the American Association for the Advancement of Science, signed by Franklin B. Hough and George B. Emerson, on behalf of the committee appointed by said association at a meeting held at Portland, Me., on the 22d day of August, 1873, to memorialize Congress with a view to elicit legislation upon the subject of cultivation of timber and the preservation of forests.

The Commissioner of the General Land-Office has from time to time, in his annual reports, invited the attention of Congress to the subject of preservation and growth of timber on the public domain as one of great practical importance to our people, and becoming every year of greater consequence on account of the increasing demand for its use, while exhaustion is going on, and no provision existing against waste or for a renewal of supply. Great public injury must sooner or later result from this cause.

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[*] Senate Ex. Doc. No. 28, 1st session 43d Congress.
[†] Since changed to the form of a bill, and given on page 2.

"Besides the economical value," so say the memorialists, "of timber for construction, fuel, and the arts, which is obvious without suggestion, and must increase with the growth of the nation, there are questions of climate that appear to have a close relation to the presence or absence of woodland shade. The drying up of rivulets which feed our mill-streams and navigable rivers and supply our canals, the failure of the sources which supply our cities with pure water, and the growing tendency of floods and drought, resulting from the unequal distribution of the rain-fall since the cutting off of our forests," &c.; for these and other potent reasons set forth in said memorial the Association for the Advancement of Science urge upon the Government the importance and necessity of taking timely action in providing against evils that must inevitably follow.

In this connection a brief review of the legislation already had as regards timber may not be out of place, its protection being an incident to the land-administration.

In 1817 (Stat., vol. 3, p. 347) Congress passed the first act for the preservation of live-oak and red cedar for naval purposes, with penalties for cutting and destroying trees, &c.

In 1831 (Stat., vol. 4. p. 472) another act was passed to arrrest spoliation. By judicial rulings and departmental decisions these laws were construed to protect all the timber on the national domain. A system of agency was then established for "protection of trees," but resulted in no substantial advantage.

In 1855 the management of the timber interests was transferred to the General Land-Office, and the registers and receivers of the different land-districts were subsequently charged, but without compensation, with the duty of protecting our timber. (See circular of instructions issued by this Office December 24, 1855; copy herewith.*) This was an improvement upon the old system, but, notwithstanding all these precautions, it has been found difficult, with all the instrumentalities at hand, to effectually correct the evil. The means are not adequate to fully suppress and put an end to the depredations and waste constantly committed, and I recognize the necessity of invoking legislation authorizing the appointment of a "commissioner of forestry," as suggested in the joint resolution submitted by the aforesaid committee for your consideration.

The act of 1873, (Stat. 17, p. 607,) the last legislation relative to our timber interests, merely protects individuals in their right to a quarter-section of land who shall plant, protect, and keep in healthy condition for a period of ten years, &c.

While this may serve to encourage the growth of timber on western prairies, some legislation appears to be indispensably necessary to prevent its wanton destruction where it now exists, and to secure a renewal thereof as it may be taken for use. I therefore heartily concur in the plan suggested for securing the necessary information as a basis for further and more adequate legislation, not only to produce but to encourage the growth of timber in all sections of our country.

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* This circular is given in a note on page 38 of this report.

The memorial and joint resolution are herewith respectfully returned.

With respect, your obedient servant,

WILLIS DRUMMOND,
Commissioner.

Hon. C. DELANO,
Secretary of the Interior.

Memorial from the American Association for the Advancement of Science upon the cultivation of timber and the preservation of forests.

At the meeting of the Association for the Advancement of Science, held at Portland, Me., on the 22d day of August, 1873, the following resolution was passed:

Resolved, That a committee be appointed by this association to memorialize Congress and the several State legislatures on the importance of promoting the cultivation of timber and the preservation of forests, and to recommend such legislation as may be deemed proper for securing these objects. Also that this committee be instructed to co-operate with national associations for a similar object.

The committee appointed consists of Franklin B. Hough, Lowville, N. Y.; George B. Emerson, Boston, Mass.; Prof. Asa Gray, Harvard University, Cambridge, Mass.; Prof. J. D. Whitney, State Geologist California, Cambridge, Mass.; Prof. J. S. Newberry, School of Mines, New York City; Hon. Lewis H. Morgan, Rochester, N. Y.; Col. Charles Whittlesey, Cleveland, Ohio; Prof. William H. Brewer, Yale College, New Haven, Conn.; and Prof. E. W. Hilgard, University of Michigan, Ann Arbor, Mich.

Under this appointment consultation has been had among members of this committee, who have requested the undersigned, on their behalf, to represent as follows:

That the preservation and growth of timber is a subject of great practical importance to the people of the United States, and is becoming every year of more and more consequence, from the increasing demand for its use; and that while this rapid exhaustion is taking place there is no effectual provision against waste or the renewal of supply.

We apprehend that the time is not distant when great public injury must result from this cause, and we deem it to be our duty to urge upon the Government the importance of taking timely action in providing against the evils that must otherwise follow.

Besides the economical value of timber for construction, fuel, and the arts, which is obvious without suggestion, and must increase with the growth of the nation, there are questions of climate that appear to have a close relation to the presence or absence of woodland shade. The drying up of rivulets which feed our mill-streams and navigable rivers and supply our canals, the failure of the sources which supply our cities with pure water, and the growing tendency to floods and drought, resulting from the unequal distribution of the rain-falls since the cutting off of our forests, are subjects of common observation.

In European countries, especially in Italy, Germany, Austria, and France, where the injuries resulting from the cutting off of timber have long since been realized, the attention of governments has been turned to this subject by the necessities of the case, and conservative measures have in many instances been successfully applied, so that a supply of timber has been obtained by cultivation, and other benefits resulting from this measure have been realized.

Special schools of forestry have been established under the auspices of government, and the practical applications of science in the selection of soil and conditions favorable for particular species, and in the planting, care, and removal of timber, are taught and applied, with the view of realizing the greatest benefits at the least expense.

There is great danger that, if not provided against, the fearful changes may happen to our largest rivers which have taken place on the Po and other large rivers of Italy, France, and Spain, caused by the destruction of the forests from which came their tributaries. These forests had retained the water from the snows and rains of winter and spring, and supplied it gradually during the summer. Since their destruction the rain falling in the rainy season comes down almost at once, bringing with it earth and stones, deluging the banks of the larger streams, but leaving a very insufficient provision for evaporation and against the consequent drought of summer.

Thus, when the forests about the sources of our great rivers shall be cut away, the water from the melting snows and early rains will be liable to come down in vast floods, overflowing the banks and carrying ruin and destruction in their course, while the affluent streams in summer will diminish or disappear, to the great injury of the country through which they flow.

We deem it highly important that the true condition and wants of the country in this regard, and the injuries that may result from the destruction of the forests and the exhaustion of our supplies of timber, should be known in time to provide a remedy before the evils are severely felt. There are facts of the greatest importance in relation to the past and present destruction of forests, the pressing want of timber-trees in States without natural forests, and the changes that have taken place, or are taking place, in consequence of the destruction of the forests, that should be carefully collected and be widely and familiarly known.

A knowledge of these facts would be everywhere of great value. They should be gathered, arranged, and so widely published as to reach the intelligent inhabitants of all the States. There is not a State or Territory without a direct interest in the subject. We should know the experience of other countries, and be able to apply whatever may be found therein suited to our soil and climate and consistent with the plan of our Government and the theory of our laws.

Individual or associated effort, unless organized and directed by authority, could not be expected to conduct these inquiries, or make known the results with that fullness which the investigation would require. We therefore recommend them as worthy of the attention of Congress, as the immediate guardian of the Territories, and the proper source of power in whatever concerns the interests of the whole country.

We would therefore respectfully request the passage of a law creating a commission of forestry, to be appointed by the President and Senate, and that it should be required to ascertain, from the most effectual and reliable means within its power, and to report to Congress upon the following subjects:

First. Upon the amount and distribution of woodlands in the United States, the rate of consumption and waste, and the measures that should be adopted to provide against the future wants of the country in the preservation and planting of timber. With this there should be an inquiry concerning the importation and exportation of lumber and other forest products.

Second. The influence of forests upon the climate, and especially as to what extent their presence or absence tends to affect the temperature, rain-fall, and other atmospheric conditions upon which agricultural success depends.

Third. A full statement of the methods practiced in Europe in relation to the planting and management of forests, and an account of the special schools of forestry that have been established in foreign countries.

Respectfully submitted.

FRANKLIN B. HOUGH,
GEO. B. EMERSON,
On behalf of the Committee of the American Association for the Advancement of Science.

WASHINGTON, D. C., *February* 6, 1874.

WASHINGTON, D. C., *March* 10, 1874.

SIR: The preceding memorial, having been transmitted to Congress by the President, upon the recommendation of the Secretary of the Interior, and in accordance with the wishes of the Commissioner of the General Land-Office, and having been referred in the House of Representatives to your committee for examination and report, I deem it proper to submit the following statements and views in support of the measures recommended in the memorial above referred to.

In so doing, while I would cheerfully award to my venerable and esteemed associate, whose name is appended with mine to that instrument, the most ample credit for the active interest which from its earliest inception he has taken in this measure, and especially in the preparation of the memorial itself, I would be unwilling in his absence to compromise his high reputation as an author and life-long student in forestry by any faults that may appear in the following pages, and will, therefore, assume them myself, unless the authority from whence derived is expressly stated. In that case, their insertion becomes but an error in judgment, and as such I would beg your favorable indulgence.

Very respectfully, your obedient servant,

FRANKLIN B. HOUGH,
Chairman of Committee of American Association for the Advancement of Science upon the subject of Forestry.

The Hon. WASHINGTON TOWNSEND,
Chairman House Committee on Public Lands.

OUR FORMER AND PRESENT TIMBER-SUPPLY.

At the period of European discovery the region of country east of the Alleghany Mountains, and over a vast extent of country to the west of that range, was covered with a dense forest. These woodlands were particularly heavy in the Northwestern States, in a large extent of the South, and especially so along the low lands adjoining the rivers. On the western coast the timber was, with some noted exceptions, chiefly limited to the region between the Pacific and the Coast range, especially toward the north and adjoining British Columbia. These forests appear to have existed through a period extending indefinitely back into the past, although, from the indications seen in the mound regions of the West the surface they covered may have once been partially cleared; yet these improvements had been so long abandoned that the most massive timber grew upon these ruins, and the decaying trunks of others that had fallen from extreme age everywhere bore witness of their great antiquity.

Other extensive regions were prairie, and had never within our knowledge borne a forest; and others were what have commonly been termed *deserts*, which name we now understand to apply to certain barren and alkaline regions, mostly destitute of vegetation, because wanting in water, and seldom visited by rains. In the State of Texas alone, it is represented that there is an area four times that of the State of Pennsylvania without a tree or a shrub. This treeless region extends northward in a broad belt of vast extent, (with some notable exceptions,) nearly across our Territories, and westward to the Coast range of the Pacific States. It is believed that the soil throughout this region, as on the prairies, contains the mineral elements requisite for highly successful cultivation, and that water alone is wanted to develop these natural resources.

Within the region formerly timbered the work of clearing began with the first settlement, and steadily went on as it extended. The pioneers, in their efforts to subdue the forests to make room for cultivation, saw in the excessive abundance around them little cause to apprehend a scarcity in the future, and an apparently inexhaustible supply led to unlimited waste. This work of destruction, begun with necessity and continued without reflection, has gone on until in every section of the country we begin to see its injurious effects, and our fields over extensive regions are left without a tree to shelter them from the sun and the winds.

STATISTICS OF TIMBER-SUPPLY.

An estimate has been made that the percentage of woodlands in the several countries mentioned in the following list is:*

	Per cent.		Per cent.
In Norway	66	In United States	25
In Sweden	60	In Belgium	18½
In Russia, in Europe	40	In France	16¾
In Germany	26½	In Switzerland	15
In Sardinia	12½	In Denmark	5½
In Holland	7.1	In Great Britain	5
In Spain	5½	In Portugal	4½

From estimates, based upon the census of 1870, it is stated that the amount of woodland in the United States is about 380,000,000 acres, the whole area improved and unimproved being 2,311,544,959 acres. The percentage by States and Territories is estimated as follows:†

	Per cent.		Per cent.
Alabama	56.0	Delaware	28.0
Arkansas	51.4	Florida	60.0
California	4.1	Georgia	54.6
Connecticut	24.4	Illinois	19.6

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* These percentages are given on the authority of Rentzsch, a German writer, except as to Russia, where it is from an official statement, by P. N. Werekha, in a recent pamphlet entitled, "*Notice sur les Forêts et leurs Produits*," (St. Petersburg, 1873,) and as to the United States, in which it is from census data and estimate. A later and very reliable authority, cited in the following pages, gives the percentage of German forests as 25.7.

† Report of Commissioner of Agriculture for 1872, p. 46. The census included only farm-lands, leaving untouched the wild unoccupied regions of the old States and the lands owned by the Government in the new. As deduced from returns of improved

	Per cent		Per cent.
Indiana	39.6	Pennsylvania	31.9
Iowa	16.2	Rhode Island	33.7
Kansas	11.2	South Carolina	53.2
Kentucky	48.9	Tennessee	55.0
Louisiana	56.9	Texas	41.6
Maine	38.1	Vermont	30.6
Maryland	31.8	Virginia	45.7
Massachusetts	25.8	West Virginia	51.1
Michigan	40.7	Wisconsin	29.3
Minnesota	20.6	Alaska	30.[illegible]
Mississippi	60.6	Arizona	5.9
Missouri	41.3	Colorado	9.9
Nebraska	10.2	Dakota	3.0
Nevada	6.4	Idaho	14.9
New Hampshire	29.0	Indiana	7.9
New Jersey	24.0	Montana	15.9
New York	25.5	New Mexico	6.0
North Carolina	60.6	Utah	9.9
Ohio	31.7	Washington	33.1
Oregon	31.8	Wyoming	7.9

The States arranged in the order of relative abundance, according to the above estimate, would stand as follows: North Carolina and Mississippi, (alike;) Florida, Louisiana, Alabama, Tennessee, Georgia, South Carolina, Arkansas, West Virginia, Kentucky, Virginia, Texas, Missouri, Michigan, Indiana, Maine, Rhode Island, Pennsylvania; Maryland and Oregon, (alike;) Ohio, Vermont, Wisconsin, New Hampshire, Delaware, Massachusetts, New York, Connecticut, New Jersey, Minnesota, Illinois, Iowa, Kansas, Nebraska, Nevada, and California.

The census reports statistics of timber in forests with perhaps less accuracy than any of its other inquiries. Large tracts are owned by non-resident proprietors, from whom the assistant marshals can obtain no data, and when returned as "unimproved" land, it is still very uncertain as to how much it may be depended upon for timber-supply.

OTHER ESTIMATES.

A statement was made in a paper read during the last year before the National Board of Trade at Chicago, by one of the most experienced lumbermen of Canada,* to the effect that at present rates of exhaustion the timber-supply of Canada would not last more than ten or twelve years for the more important kinds. These assertions appear to have been made deliberately, and are accompanied by details showing an extensive acquaintance with the business of which he speaks.

These statements are reviewed in an article published in the "Lumberman's Gazette,"† a journal devoted to the interests implied in its title, by a writer who is mentioned as "a veteran lumberman and careful observer,"‡ in which he points out the errors of the above calculations, and enters into details to show that our supplies, instead of failing in *ten* years, will last for at least *twenty*. The aggregates are ex-

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and unimproved lands in farms, the forest area is 39 per cent. The amount of wood land not included in the returns is estimated by the statistician of the Department of Agriculture from general information, and should therefore be received as only an approximation, but the best of the kind that we have. The rules upon which this estimate is made are stated in the report from which we quote, page 46.

* Mr. James Little, of Montreal. The statement as to the place where this paper was read is from a newspaper authority, and is liable to error.

† Published at Bay City, Michigan, December, 1873; vol. iii, No. 6, p. 191.

‡ Colonel Waite, well known as an intelligent judge of questions relating to the lumbering interests.

pressed in board-measure, and, if we understand him, chiefly or only relate to pine.

Maine	1,500,000,000
New York	900,000,000
Pennsylvania	7,000,000,000
Michigan	50,000,000,000
Minnesota	18,000,000,000
Wisconsin	16,000,000,000
West Virginia	7,000,000,000
Virginia, (yellow pine)	150,000,000
South Carolina	90,000,000
North Carolina	1,600,000,000
Florida	1,700,000,000
Georgia	1,500,000,000
Total in these States, east of Rocky Mountains	105,440,000,000
Dominion forests	73,000,000,000
Total, east of Rocky Mountains	178,440,000,000
West of Rocky Mountains	70,000,000,000
Total, United States and Canada	248,440,000,000

We can, of course, assume no responsibility with reference to the correctness of these figures, or those in documents which follow. We give them as we find them, and the authority upon which they are founded:*

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* The statement of the writer first noticed (Mr. Little) goes into details as follows in speaking of the pine-crop:

"These supplies are chiefly found in Maine, New York, Pennsylvania, Michigan, Minnesota, and Wisconsin. The supply in Maine is nearly gone, and the people are using spruce as small as six inches in diameter. Pennsylvania uses 500,000,000 feet of her diminishing stores every year, and her remaining stock will be gone in five years. Northern New York, which has furnished 300,000,000 feet annually, is to be shut out by the appropriation of the Brown tract for a public park. The draught upon Michigan last year was 2,910,000,000 feet. This year it reaches 2,000,000,000. He also avers that during the next twelve years, judging from the past, this country will require 70,000,000,000 feet of lumber, and that we have not more than one-half of that amount remaining in the woods."

The reviewer of Mr. Little's statements says: First in the catalogue, we go to Maine, as he has done, and are free to admit that she is shorn of nearly all her choice groves of pine. Yet five years hence will find her good for no mean sum of millions of that staple, still valuable, and many more of hemlock and other timbers. New York, long years ago supposed to have been entirely depleted, will also then pick up some stunted yet priceless millions. Pennsylvania will furnish a half billion of feet for *fourteen* years to come. Michigan, notwithstanding the huge drain from her of 2,910,000,000 for 1872, and the 2,317,000,000, (or thereabouts,) for 1873, is yet competent to cast upon the market of the world 2,500,000,000 for another *twenty* years, with two-thirds of that sum of choice hemlock, if it be not destroyed by fire or otherwise depredated ruthlessly. Minnesota has proved, by her energy in furnishing 700,000,000 for 1872 and 800,000,000 for 1873, that she can "go" another 100,000,000, and make good that status full *twenty* years. Wisconsin, selling in 1872 600,000,000, and in 1873 cutting nearly 700,000,000, can likewise "see" her 100,000,000 more and keep well up to that deal for twenty years also. West Virginia has by low estimate 7,000,000,000 feet of choice pine, and not less than half a billion of whitewood or poplar, equal in value to the pine, and the same amount of white-ash, still more valuable. Virginia proper counts 150,000,000 of yellow pine; South Carolina, 90,000,000; North Carolina, 1,600,000,000 yellow pine, and almost limitless swamps of cypress, juniper, and other forest-trees, live-oak included. Florida, 1,700,000,000, also yellow pine. Georgia, about 1,500,000,000, while Missouri, Alabama, and Texas, are known to embrace much of forest-soil covered with a heavy growth of timber, amid which there is no mean sprinkling of pine, but with these forests my memoranda are of too superficial a character to base sound estimates upon, so I will cast them into the collection to make up for shrinkage.

"All this aggregate grows on Uncle Sam's homestead farm, while his out-lying dominions beyond the Rocky Mountains, within a belt of two hundred miles by several thousands, can show more feet of choice red-wood and pine, I am told, than any two of the best of our pine States dare boast of. And now a word for our neighbors of the

The "Evergreen and Forest-Tree Grower," a monthly, devoted to the consideration of the subjects embraced by its title, has a valuable article on the imminent need of action of the people in all parts of the country, especially in the East, to provide for the future by planting trees. From the article we take the following remarks:

> Having visited the centers of our lumbering trade, and carefully gathered statistics, we fine that, at the present rate of waste, seventeen years will complete the destruction of our pineries. It is estimated that five years will suffice for the forests of Maine, once supposed to be exhaustless. Soon after our pine is gone our fine hardwood forests (which now supply the immense manufactories, the agricultural enterprises, and car-works) will be destroyed, and then the remaining timber will suffer very severe draughts. Thirty years will inevitably see large tracts at the East denuded of lumber, while beautiful groves, large enough for building and manufacturing, will adorn many portions of the West. If properly cultivated and tended, trees will grow to a good size in thirty years. There is a great difference between a natural and an artificial forest. Before us, as we write, is a section of a Scotch pine 13 inches through, and the tree was 35 feet high. Go into many of our well-kept artificial forests, and you will often find that trees often make a diameter of one inch a year, and a height of 2 feet; and we have known white pines to grow even 3 and 4 feet a year. The soft woods often show a yearly circle of an inch in thickness, giving a diameter of two inches. (Lumberman's Gazette, May, 1873, ii, 11.)

The "Jackson Pilot" (Mississippi) is quoted as saying, in reference to the immense drain made upon timber throughout the United States, and which is rapidly denuding the Northwest of her forests, and in regard to the "inexhaustibility" of our timber, as follows:

> If the lumber-supply were drawn from Mississippi for the whole country for five consecutive months, it would not leave a tree standing in the State. We have a plentiful supply of fine timber on hand, but instead of being anxious to get rid of it we should rather prefer to hold on to it until prices should have advanced to double or quadruple to what they are now—as surely they will. Every tree that can be converted into timber should be carefully preserved, and the sapling and undergrowth encouraged to develop into steady growth as rapidly as possible. It is no exaggeration to say that, in twenty years, if the consumption of lumber goes on at the present rate, every acre of well-timbered land in Mississippi will be worth $100 to its possessor. We repeat, therefore, that to take care of our timbered lands should be to us a grand consideration. Millions of feet of valuable lumber are annually lost to our State by the wanton or needless destruction of our trees. The noblest monarchs of the forest are felled without mercy, and, apparently, without object. Put an end to this at once. Regard every tree as a piece of property that is daily increasing in value, as the forests in other sections are rapidly disappearing under the stroke of the woodman's ax. The "piney woods" of Mississippi will yet prove a mine of wealth, more valuable than the gold-fields of California. Keep them free from the depredation of fires and coon-hunters. (Lumberman's Gazette, June, 1873, ii, 197.)

We will add another opinion upon this question of supply and use of timber, which appears as an editorial article in the journal from which the foregoing has been quoted:

> The great forests of the Western States are fast disappearing; the most of those of the Middle and Eastern States went long ago. In the whole United States but one vast tract of timber is left untouched. That covers about one-half of Washington Territory and one-third of Oregon. Here the yellow pine thrives in the greatest perfection, some of the trees reaching 300 feet in height.
>
> The demand for lumber increases in the United States at the rate of 25 per cent. per annum. The decrease of forests is at the rate of 7,000,000 acres annually. Few people have any idea of the immense value of the wood which is used for purposes generally considered unimportant. The fences of the United States are now valued at $1,800,000,000, and it costs, annually, $98,000,000 to keep them in repair. By far the greatest proportion of these are wood. The railroads of the United States use 150,000,000 of ties annually, costing from 50 to 80 cents each, and these have to be re-

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New Dominion, whose interminable forests are yet scarce opened, many of them as yet inaccessible and certainly have had no adequate estimate of their timber or its value. I believe, however, that the enormous amount of 100,000,000,000 of feet would scarce cover the sum total of the different species of pines, firs, and spruces embraced within the Dominion forests." (Lumberman's Gazette, vol. iii, 191.)

newed once in every seven years. In 1871, 10,000 acres of forest were stripped of their timber to supply fuel for the single city of Chicago. In twenty years scarcely anything will be left of the vast forests of Wisconsin, Michigan, and Minnesota, and too late our farmers will see how short-sighted they have been in not making provisions for supplying the great demand for lumber which this wide-spread destruction is certain to cause.—(Lumbermen's Gazette, August, 1873, iii, 37.)

An article published in the "American Agriculturist," New York, thus presents the subject of timber-waste:

The annual products drawn by the people of the United States from the forest exceeds $1,000,000,000, or eight times the interest on the national debt. This being the case, the preservation of our forests is a matter of general interest and of national importance.

To save our timber, we must not only cut no more than is necessary, but cut it in a proper and economical manner. We must stop the merciless waste and primitive method of chopping with axes, and use saws, scientifically. The forests of Europe are protected by law, and the removal of their timber is carefully and economically performed.

Not to speak of the decrease of moisture and other climatic changes superinduced by removing trees, let us look at the matter of low aspect, and compute the profit and loss.

Probably not less than 30,000,000 of the people of America are warmed by wood fuel, consuming more than 100,000,000 cords per annum, as any one knowing the prodigal use in our newer timbered districts will certify. If mills, railroads, and steamboats consume one third as much, reckoning the cost at $3 per cord, we have $400,000,000 annually for fuel alone. An equal consumption of timber for fencing, and a vast amount for wooden buildings of all kinds, give the enormous aggregate of $1,200,000,000 annually, produced by our forests for consumption.

When we consider the fencing and farm-buildings required by our more than four million farms, if reckoned at $150 annually to each farm, making $600,000,000, and when all the uses of wood are considered, few men who have traveled will deny that more than $1,000,000,000 in products is derived from our forests annually—five times the production of our pig-iron, twelve times our production of gold and silver, and four times our wheat crop. Indeed, few single interests exceed in value the enormous production of our forests.

Timber may be cut with saws. Some of the advantages of this over the wasteful and primitive ax, are: First, the trees can be cut closer and with greater economy than by chopping, and, by the use of wedges, felled in any desirable direction. They can be cut with less labor, if the operator knows how, and uses the most improved saw. If the tree be designed for fuel, the saving of fuel by sawing it the length desired on the ground in the forest is manifest. If for stove-wood, the blocks may be carted without splitting; and when thus sawed, trees that any chopper would leave to rot in the forest become instantly available, for who does not know that a one-foot block may be split easier than one of four feet, besides the immense waste of chips a foot in width? From one-third to one-fourth of the trees in many forests are what woodmen regard as "culls" and tough timber; this, added to the saving of the chips, makes fully one-third of the forests available for fuel that might otherwise be wasted and remain an obstruction and incumbrance. Those who, like the writer, are conversant with this matter, will appreciate this statement, made from actual experience.

Saw-logs and dimension timber, fencing, posts, &c., in the Northern States are now usually sawed; but in a recent trip through all the Southern States, (except Texas,) I noticed in mill and lumber yards the splintered ends of saw-logs cut with axes; indeed, this is the general method of country mills there, but improved methods will soon prevail everywhere in all wood-cutting.

Now let us consider the time and labor saved by sawing instead of chopping. To cut 100,000,000 cords of wood with the ax requires as many days' labor and as many dollars; if the use of hand cross-cut saws be substituted, and only one-half the labor saved, the 50,000,000 now thrown away are gained, besides the immense waste of fuel, making in the two items of annual saving of an amount equal to the interest of the national debt.—(Quoted from the Lumbermen's Gazette, April, 1873, iii, 133.)

ANOTHER OPINION CONCERNING THE PINE-FORESTS OF MICHIGAN.

A writer to the Detroit Tribune, quoted in the Saginaw Daily Enterprise of February 21, 1874, in speaking of an estimate printed in the journals of the day to the effect that the aggregate amount of standing timber in Michigan was equal to 33,000,000,000 feet, board measure, says:

Thirty-three thousand millions of feet of timber sounds very large, and if standing in a body upon a strictly pine district would cover 3,300,000 acres. But it may be said that these figures cannot be relied upon. It is true that the figures may be erroneous so far as relates to the actual amount of pine now standing in the forests of Michigan. The figures are based upon estimates which have no doubt been carefully made from the best information at hand. The actual amount of pine-timber now growing in our forests cannot be known without an actual and careful scaling of all the timbers. The present consumption of timber, and the consequent exhaustion and constant diminution of the stock, however, can be and are known. And this reveals the true condition of the case.

Whatever may be the amount of supply, there is an inexorable depletion which each year exhausts hundreds of thousands of acres of pine. What of it? Why is there so much time expended in these calculations? Why so many newspaper articles about the pine forests and their destruction?

I would like to make a few suggestions upon this subject, and, in the first place, I will say that, while this peninsula was in a wilderness condition, with no highways, no railroads communicating with the interior, the streams of this State were the channels of supply for lumber; and upon the lower waters of these streams the lumbering business was carried on from small beginnings until it became the most important manufacturing interest in the State. The lumbermen were gradually extending their operations up these streams, securing the pine-timber at low rates, and endeavoring to keep a supply of low-priced lands on the upper waters of the streams, which they occupied, for future use, when the timber on the lower waters should be exhausted. The selection of over 500,000 acres of land by the Saint Mary's Falls Ship-Canal Company in 1853 was accompanied by the location of large tracts of pine by individuals, and it is probable that over a million of acres were selected in 1853 and 1854. It was then supposed that the choice lands of the State were nearly, if not quite, taken up. But this peninsula was a wilderness, and a large area of the pine was still held by the Government.

Then followed the grants of land made by the Government to the railroads, covering over 1,000,000 acres. These grants covered only alternate odd sections, leaving in the hands of the Government the even sections within the railroad limits. These land-grants were not appreciated by the parties who inaugurated the railroad enterprises, and the interest of these railroads did not extend beyond the few individuals who were interested in them. So there was little effort made to build the roads. The crisis of 1857 intervening tended to destroy, for the time being, all hope of securing the necessary means to complete these roads. Lumbermen in the mean time labored with a depressed and disorganized market, and almost any business was preferable to that of lumbering. During the years from 1857 to 1863 the pine-lands and lumber interest were so depressed that there was no incentive to increased operations. The canal company's lands were sold at auction and distributed among the stockholders in 1863, at prices so low as to astonish every one who now looks at their catalogue of prices. From this date the interest in pine-lands began to increase and prices to advance, and individuals again became interested in securing such of the Government lands as contained pine-timber. The railroads were being constructed, and this immense grant of lands made by the Government was found to include some of the most valuable pine-timber. Prices advanced, and until the crisis of last fall it seemed as though no limit as to value could be reached, when the timber was favorably located. From 1863 to 1866, $10 per acre was considered the maximum price for first quality of pine, and very many lands were sold at much less. But the enhancement of prices continued until lands were sold at $25, $30, $35, $40, and $50 per acre in favorable localities. To Michigan men these prices seem high—and these are exceptional rates, especially above $25 per acre; but when compared with the prices in Pennsylvania, where the timber is nearly exhausted, the prices are not high. Indeed, the price of timber-lands at present can hardly be reckoned by the acre, for in all cases where large prices per acre are obtained it is the timber that governs the price—the amount and quality of the timber; and so lands which are denominated pine-lands may, in the same region, bear prices ranging from $5 to $25 per acre.

And this condition of things is not confined to the localities on the streams which in former years governed the price of lands. The railroads extended across the State from Saginaw to Lake Michigan, and from Grand Rapids and Lansing, northward, toward Mackinaw. Two routes, penetrating the central portion of the State, reaching the head-waters of our lumbering-streams, are opening to the markets of the country in all directions the reserved bodies of pine, which have been relied upon for the future supply of mills on the different streams entering into Lakes Huron and Michigan. A very large lumber-trade is now carried on along the line of these railroads, and to-day this whole peninsula is practically open to the lumber-business.

It seems to me that it is not a question of so much interest to us as to how much pine-timber there is in Canada, or in Wisconsin, or in Minnesota, or in Georgia, or in Florida. The southern peninsula of Michigan has a remarkably favorable situation in reference to this great lumber-interest. We are surrounded by the great lakes, and have the best water-communication, by means of our large rivers, from the timber-regions to points of shipment by water, and we have those extensive railroad-facilities which leave scarcely a spot in the whole State which cannot be made a manufacturing point for lumber.

The markets which are supplied with timber from Michigan cannot as well be supplied from Washington, and our timber is superior in quality to that of any pine-region in this country, so that I think there is reason for inquiry; there is reason for anxiety. We have this natural treasure within our borders, and it is our duty to see that it is not wasted. It is more than a pecuniary loss when lumber is manufactured before the demand, so that prices of the manufactured article do not cover the cost. Some means should be devised to prevent the over-cutting of this timber, and I trust that the meeting at Lansing on the 10th of March will organize some mutual, harmonious, and practicable plan of preserving and protecting the pine-forests of the State.*

Remarks on the foregoing.

It is worth the attention of the owners of timber-lands, not only in Michigan but throughout the country, to study the great timber question in view of the future as well as the present. Wherever there is anything to be saved in the processes of manufacture, save it. Let nothing be thrown away that can be made of any value, and in looking over the operation of machines it is well to remark that some waste much more than others, which do as much and as good work. More especially consider the economies of timber-growth, and spare the young pines till they are worth cutting. Take only the timber of full growth, where this can be done consistently with reasonable management, and let waste places grow up again in timber, which they will often do without expense, if let alone and shut out from injury by sheep and cattle. The fable of the golden egg has a direct and forcible application to our native forests, which, under intelligent management, may be made to yield an annual tribute of gold value, but if cut off, yield nothing for future wants.

Methods of management practiced in European forests, and which the experience of centuries has brought to great perfection, should be made available for our benefit, not only so far as it will apply, but in cases where it will not apply; lest those of less opportunities for knowing this fact may attempt to follow that which leads only to disappointment and loss. A law or rule of practice not applicable, may often be as serviceable in its warning as a well-grounded fact is useful in its teachings.

The mythical story of the sibyline leaves may have been but an allegorical precept of the universal fact, that objects of absolute necessity enhance in value as they diminish in quantity, and had the illustration of this idea been drawn from forests, it could not have been more appropriate. In short, let the leaves of the books be regarded in a literal sense as the leaves of the trees, and the application is as exact, as the inference is complete.

CENSUS LUMBER-STATISTICS.

The ninth census reports the total amount of lumber, &c., manufactured in the year preceding 1870 as follows:

Laths	1,295,091,000
Lumber	12,755,543,000
Shingles	3,265,516,000
Staves, heading, &c., (value)	$10,473,681
All products, (1870)	$210,159,327
In 1860, the products were	$96,715,857

Increase in value in ten years about 117 per cent.

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* The meeting alluded to was held, and an organization formed for the purposes above indicated.

That an idea may be formed as to the distribution of the lumber business, we quote the following table from the Census of 1870:

States and Territories.	Laths.	Lumber.	Shingles.
	Thousand.	*Thousand ft.*	*Thousand.*
Alabama	1, 115	97, 192	1, 422
Arizona	....	1, 200	....
Arkansas	2, 200	78, 692	4, 747
California	2, 877	318, 817	103, 547
Colorado	2, 710	13, 625	3, 675
Connecticut	813	56, 482	15, 810
Dakota	....	3, 894	....
Delaware	100	18, 858	....
Florida	1, 400	158, 524	....
Georgia	1, 883	245, 141	1, 560
Idaho	....	1, 490	400
Illinois	13, 650	245, 910	40, 929
Indiana	11, 202	656, 400	73, 707
Iowa	47, 884	325, 285	97, 928
Kansas	320	74, 163	12, 108
Kentucky	8, 050	214, 044	13, 573
Louisiana	8	76, 450	....
Maine	266, 889	639, 167	364, 201
Maryland	5, 849	96, 165	3, 809
Massachusetts	873	197, 377	36, 466
Michigan	304, 054	2, 251, 613	658, 741
Minnesota	49, 768	242, 390	137, 813
Mississippi	651	160, 564	5, 500
Missouri	12, 970	329, 676	10, 442
Montana	400	12, 571	2, 356
Nebraska	....	13, 824	900
Nevada	75	35, 025	700
New Hampshire	10, 383	253, 434	52, 225
New Jersey	3, 167	101, 829	3, 634
New Mexico	....	6, 900	....
New York	87, 999	1, 310, 066	372, 163
North Carolina	1, 530	124, 938	13, 167
Ohio	15, 238	557, 237	59, 632
Oregon	7, 346	75, 193	....
Pennsylvania	95, 592	1, 629, 631	275, 273
Rhode Island	....	12, 732	5, 119
South Carolina	2, 500	95, 098	1, 200
Tennessee	5, 370	204, 751	11, 337
Texas	623	106, 897	30, 209
Utah	1, 138	11, 741	8, 061
Vermont	6, 672	241, 667	28, 502
Virginia	4, 258	144, 225	614
Washington	17, 000	128, 743	10, 450
West Virginia	197, 871	76, 375	5, 000
Wisconsin	102, 663	1, 098, 199	806, 807
Wyoming	....	3, 260	750
Total	1, 225, 091	12, 755, 543	3, 265, 516

It will be seen from the above table, that Michigan takes the lead in lumbering interests, being followed by Pennsylvania, New York, and Wisconsin as second, third, and fourth in the order of relative importance.

We are inclined to believe that the returns of the census are below the actual amount rather than above, and that the consumption of lumber products of various kinds, not including those made and used upon farms, if represented in board-measure, would exceed 20,000,000,000 feet a year.

From this estimate it is evident that our supplies are rapidly wasting away, *while almost nothing is being done to replace them*, beyond the spontaneous efforts of nature. At present rates of exhaustion, the present generation must begin to feel with great severity the evils that must inevitably follow in the want of this essential material, even allowing a broad margin for errors in the estimates we have given, and placing the subject before us in the most favorable light it will bear.

USES OF LUMBER IN THE ARTS.

The last census, referring to the business of 1869, reports 63,928 establishments manufacturing articles made entirely from wood, employing 393,387 persons, and using materials worth $309,921,403 annually.*
There are besides 109,512 industries in which wood is an important part; as for example—carriages, furniture, bridges, ships, &c., employing 700,915 persons, and using materials worth $488,530,844.† If we

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* The details which furnish these aggregates are as follows:

Manufactures.	No. of establishments.	Persons employed.	Value of materials.	Manufactures.	No. of establishments.	Persons employed.	Value of materials.
Bark, ground	33	133	$194, 491	Lumber, sawed	25, 817	149, 871	$103, 102, 393
Baskets	127	920	138, 109	Oars	25	191	45, 845
Bee-hives	15	33	8, 459	Sash, doors, & blinds	1, 605	20, 379	17, 581, 814
Boxes, cheese	194	694	242, 937	Wood-brackets, moldings, and scrolls.	65	747	636, 423
cigar	104	783	477, 499				
packing	489	4, 509	4, 236, 745				
Cooperage	4, 961	23, 314	12, 831, 796	Wooden-ware	260	3, 169	1, 623, 694
Hubs, spokes, wheels, &c.	302	3, 721	2, 204, 713	Wood, turned and carved.	733	4, 113	1, 648, 008
Kindling-wood	70	701	486, 642	Wood, miscellaneous	1, 001	2, 318	3, 504, 052
Lasts	60	510	137, 657				
Lumber	26, 945	163, 637	132, 071, 778	Total			
planed	1, 113	13, 640	28, 728, 348		63, 928	393, 383	309, 921, 403

† The details producing these totals are as follows:

Manufactures.	Number of establishments.	Persons employed.	Value of materials.
Bellows	13	117	$106, 735
Billiard-tables	39	505	650, 864
Boats	174	2, 381	1, 214, 016
Bridge-building	64	2, 069	3, 239, 771
Brooms and brushes	635	5, 206	3, 672, 837
Building	24, 908	112, 820	95, 694, 665
Building materials	33, 207	251, 582	173, 198, 451
Carpentering and building	17, 149	67, 864	65, 943, 115
Carriages and sleds, children's	53	913	495, 261
Carriages and wagons	11, 847	54, 928	22, 787, 341
Cars, railroad, and repairs	170	15, 931	18, 117, 707
Charcoal and coke	167	3, 473	1, 204, 779
Coffins	642	2, 365	1, 412, 078
Furniture, &c	{ 6, 312	57, 001	28, 516, 544
	{ 5, 423	40, 554	21, 660, 837
Furniture, chairs	529	12, 462	3, 979, 743
Furniture, refrigerators	97	267	192, 409
Machinery	1, 737	30, 781	22, 575, 692
Matches	75	2, 556	1, 179, 666
Mill-wrighting	180	507	384, 787
Patterns and models	165	867	235, 933
Pumps	465	1, 905	970, 547
Ship and boat building	971	14, 051	9, 727, 820
Ship materials, &c	762	11, 063	8, 252, 394
Show cases	47	353	419, 466
Toys and games	49	615	159, 946
Washing-machines, &c	64	462	454, 502
Wheel-barrows	23	238	166, 420
Wheelwrights	3, 613	6, 989	1, 907, 418
Total	109, 512	700, 915	488, 530, 844

We are well aware that the numbers in both this table and the preceding are liable to the criticisms that the same material may appear more than once. It is from a defect in the census, which might be remedied under a better law, but scarcely under the present very defective one. The judgment of the reader must supply whatever assume that half of the latter class of mixed manufactories are employed upon articles of wood alone, we have a grand total of 118,684 establishments, employing 7,439,840 persons, and using wood valued at $554,186,825 annually. We cannot conceive the consequences that would happen to our civilization were the supplies for these great industries consumed. While no one would wish to see the consumption of wood for use in the acts reduced below the proper wants of the country, we may justly hope that the economies of forestry and of manufacture may be most carefully studied, and that there may no longer prevail that wasteful disregard of material which is now everywhere observed. It is hoped that the important lesson may be early learned, that timber-culture is in many cases the most profitable investment of labor and capital when viewed simply as to the value of its material, to say nothing of the incidental benefits resulting to agriculture in the protection which woodlands offer to insectivorous birds,* and their influence upon the climate. We purpose further on to notice the humidity, coolness, and shelter from sun and winds which belts of woodland afford to fields of grain and to orchards and gardens.

USE OF WOOD BY RAILROADS.

Although costly experiments have been made to find inorganic materials for the road-bed of railways, nothing has yet been found that will supply the place of wood; nor have we reason to hope that the demand for ties will ever be less per mile than at present.

At the end of 1873 there were reported 71,564.9 miles of main lines, and 13,512 miles of sidings and double tracks, making 85,077.9 miles of railroad within the United States. Of the main lines 5,462.3 miles were in the New England States, 14,209 in the Middle States, 33,905.9 in the Western States, 15,316.4 in the Southern States, and 2,671.3 in the Pacific States.† Upon these roads 14,223 locomotives were running,

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allowances there may be due from this cause; but if we take into account the great number of industries not included in these tables, and the enormous waste of material in manufacture, we are inclined to believe that the allowance will tend to increase rather than diminish the totals.

* At the Land and Forest Congress, held at Vienna in September last, the first subject on the programme, after the dispatch of preliminary business, was announced as follows:

"What regulations are necessary to be adopted for the preservation of birds useful to the agriculturist?"

After a full discussion, strong resolutions were passed recommending the enactment of laws in various countries for the protection of these useful allies of the field, by stringent game-laws and other means. Obviously the most direct way to encourage their increase is to provide shelter suited to their habits, and to afford that protection implied in a generous and appreciating public sentiment, as to the real value of their services.

† New York Tribune, January 7, 1874, quoted from the Railway Monitor.

As these statistics, besides present importance, are of great historical interest, we here subjoin them:

States and Territories.	Miles, 1872.	Built in 1873.	Miles at end of 1873.
NEW ENGLAND STATES.			
Maine	891. 5	44. 0	935. 5
New Hampshire	822. 7	73. 1	895. 8
Vermont	736. 3	57. 9	794. 2
Massachusetts	1, 625. 0	113. 7	1, 738. 7
Rhode Island	133. 2	36. 9	170. 1
Connecticut	898. 3	29. 7	928. 0
Total	5, 107. 0	355. 3	5, 462. 3

and a large proportion of them used wood for their fuel. The number of ties used varies from 2,200 to 2,800 per mile. If we take 2,500 as a mean, we find that 212,692,500 pieces of timber 8 feet long and from 6 to 8 inches between upper and lower surfaces, are required to supply this single item.

States and Territories.	Miles, 1872.	Built in 1873.	Miles at end of 1873.
MIDDLE STATES.			
New York	4,884.9	398.4	5,283.3
New Jersey	1,343.7	69.5	1,413.2
Pennsylvania	5,432.5	412.9	5,845.4
Delaware	222.7	16.0	238.7
Maryland and District of Columbia	865.4	69.7	935.1
West Virginia	493.3	....	493.3
Total	13,242.5	966.5	14,209.0
WESTERN STATES AND TERRITORIES.			
Ohio	3,923.8	192.0	4,115.8
Michigan	2,973.7	222.1	3,195.8
Indiana	3,705.2	128.0	3,833.2
Illinois	6,277.7	201.4	6,479.1
Wisconsin	2,028.2	205.7	2,233.9
Minnesota	1,861.6	51.0	1,912.6
Iowa	3,640.7	203.7	3,844.4
Kansas	1,901.8	101.2	2,003.0
Nebraska	1,147.2	113.1	1,260.3
Missouri	2,769.3	129.0	2,898.3
Wyoming	454.0	....	454.0
Utah	376.0	71.5	447.5
Dakota	223.0	38.5	261.5
Colorado	551.0	105.0	656.0
Indian Ter	310.5	....	310.5
Total	32,143.7	1 762.2	33,905.9
SOUTHERN STATES.			
Virginia	1,504.7	39.8	1,544.5
North Carolina	1,263.5	17.1	1,280.6
South Carolina	2,261.2	62.0	1,323.2
Georgia	2,180.4	21.0	2,201.4
Florida	475.7	....	475.7
Alabama	1,858.6	11.0	1,869.6
Mississippi	985.4	37.0	1,022.4
Louisiana	560.0	....	560.0
Texas	1,110.7	219.7	1,330.4
Kentucky	1,195.7	201.0	1,396.7
Tennessee	1,521.1	97.3	1,618.4
Arkansas	551.5	442.0	693.5
Total	14,468.5	847.9	15,316.4
PACIFIC STATES AND TERRITORIES.			
California	1,491.3	198.0	1,689.3
Oregon	297.0	10.0	307.0
Nevada	569.0	....	569.0
Washington	55.0	51.0	106.0
Total	2,412.3	259.0	2,671.3
Grand total	67,374.0	4,190.9	71,564.9

The number of cars for passenger-trains was reported as 13,725; for freight-trains 338,427.

Capital stock paid up	$2,072,251,954
Funded and floating debt	1,999,741,597
Cost of roads and equipments	3,738,416,958

Miles of road operated on which reported earnings were based, 54,454 miles; on which gross earnings on that mileage for latest year attainable, $478,885,597; net earnings over operating expenses, (but not over the bond-interest and dividend payments,) $174,350,913.

The durability of ties varies with the kind of timber, soil, climate, and use, ranging from four to ten years. Taking six as an average, the amount required for *annual supply* must be 35,448,750 pieces, or 94,530,000 cubic feet. In considering this, we must remember that a large amount of waste occurs from hewing and from leaving the upper parts of the trees, some of which are used as firewood, the remainder being a total loss. It must also be borne in mind that the demand for timber by railroads besides for ties and for fuel is very great, including fencing, bridges, buildings, and structures of various kinds; that the risk from fires is exceptionally great, and that our requirements in this direction are increasing even more rapidly than our supplies are wasting.

FENCES.

We are entirely without official data for presenting statistics of the amount of wood used for fencing, and we only know that it is enormous and to the last degree wasteful and improvident. When we shall have learned, perhaps from necessity, but better from reason, that live hedges, walls, and ditches are often cheaper than wooden fences, and especially that it is better to keep farm-stock within the range where they are allowed, than out of the places where not wanted, it will be a most useful lesson. Again, the larger the field, of course the less, relatively, it will cost to inclose it, so that by a short calculation we may readily see that were the field about twenty miles square, one rail would fence an acre of ground. This thought has its application in such great grazing regions as Southern California, where fencing materials are scarce and costly, and is not without its use in all grazing districts.

FUEL.

The use of timber for firewood is also of the greatest importance, but its amount can only be vaguely estimated. It does not require an old man's memory to reach back to the time when wood was the fuel in all our cities, and when it was used everywhere in running steamboats and steam-machinery. Even now mineral coal is not used far from the mines, except along navigable waters and lines of canal and railroad transportation. If we admit that three-fourths of our forty millions of people use wood as their fuel, and that five cords supplied the wants of a family of five persons, the annual demand would be 30,000,000 cords. The actual amount used as fuel or burned on the ground is, however, vastly beyond these figures, especially in timber regions, and would probably exceed 100,000,000 cords annually.

FIRES AND OTHER DESTROYING AGENCIES.

The destruction of timber by running fires is too well known to need a reminder, and the havoc from this cause in the autumn of 1871, in Wisconsin and Michigan, was too fearful to be soon forgotten; so great, indeed, that but for the greater calamity that swept away so many millions of dollars' worth of lumber and of wooden structures in Chicago the same year, these forest-fires would stand as among the greatest of our national calamities. They are usually caused by accident or by carelessness of farmers or hunters, or are purposely set by Indians for driving game, and they have in single years, in different parts of the country, wrought a greater destruction of timber than the wants of the nation would then have called for. The remedy must be sought in a strict enforcement of regulations like those devised and executed in foreign countries, sustained by laws, and by a strong public sentiment in favor of their rigid observance. The pursuit and punishment of the man who had willfully set fires to run in the woods should be as certain and effectual as of the wretch who would set fire to a harvest-field.*

Among other agencies destructive to forests may be reckoned the ravages of insects; disease, from whatever cause; the killing off of timber by accidental or artificial obstructions in streams, causing overflow; and vicissitudes of climate. In the great wilderness of Northern New York there are places where nothing can be seen as far as the eye can reach, in every direction, but dead and decaying spruce timber. Is this from insects? Is it from some severe exposure in winter, or from some drought of summer? It is the province of science to ascertain the causes of these immense losses, and, if possible, to devise the means whereby they may be lessened.

Should the measure recommended by the bill accompanying this report become a law, it would be the duty of the forest commission to cause inquiries to be directed to these among other subjects of practical utility in our forest economy.

EFFECT OF FORESTS UPON RIVERS AND WATER-COURSES.

It is within the knowledge of every intelligent observer that the streams diminish or disappear as the woodlands are cleared away. The river Elbe, between the years 1787 and 1837—a period of half a century—diminished at Altenbrücke, in Hanover, ten feet in depth, as a direct result of the cutting off of forests in the region where the tributaries have their origin.† The causes of this effect, so constantly observed, may be attributed to several reasons: The soil in woodlands is more absorbent and pervious to water; the ground is covered with leaves and mosses, and the streams, up to the smallest rills, are incumbered with substances that retard the flow of waters. Besides this, evaporation is there checked, and the bed of air near the surface, when saturated with vapor, is not carried away by the winds or dissipated by being warmed by the sun.‡

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* Some of the seignorial grants in Canada in the times of Louis XIV, and the land-patents granted by the colonial government of New York, had stipulations in relation to precautions against fire which would be of great practical value at the present day.

† Report of Henry J. Wisner, United States consul at Sonneberg, to the Department of State, November 1873.

‡ An elegant French writer upon forest economy, JULES CLAVÉ, in a work entitled "*Études sur l'Economie Forestière,*" thus clearly describes the processes of nature by which forests maintain and equalize the flow of water:

RAINS.

The first phenomenon that offers for our inquiry, in the study of the regulation of the waters, is *rain*. It is this that gives rise to springs and rivers, and that in certain conditions of continuance occasions inundations.

Rain is caused by the precipitation of the vapor held by the atmosphere, and this precipitation is commonly caused by cold and humid winds. When these winds come to us [in France] from the ocean or the Mediterranean, and pass over a place where the temperature is too low to hold these vapors in suspension, they condense and fall as rain. For this reason, mountainous countries, being generally colder than the plains lying in the same latitudes, all other circumstances being equal, are more liable to frequent rains.

It has been claimed that the presence of forests, like mountains, have the effect of lowering the temperature, and by this means of increasing the abundance of rains as well as of diminishing their violence. It cannot be doubted that forests have the effect of sheltering the surface from solar heat, and of causing a cutaneous exhalation from the leaves, while they multiply, by the spreading of their branches, the amount

COMMUNITY OF INTEREST IN RIVERS.

Let us next consider the public rights involved in the navigation of rivers, the permanent condition of which interests all who dwell

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of surface cooled by this evaporation, and thus have a cooling effect; but this, in fact, is far from being general; and especially in our climate it is often marked, and even neutralized, by local circumstances, such as the physical properties of the soil, the topographical situation of the place, the direction of prevailing winds, &c. If it is certain that the mean temperature of our country is higher than was in Gaul in the days of Cæsar, when it was covered with forests, we must nevertheless admit that while a forest protects the surface from cold winds it does not tend to raise the temperature, and that if cut away a refrigeration would not be thereby necessarily produced. Thus, for example, it has been proved that the department of l'Ardèche, which is now without a single considerable piece of woods, has shown, during the last thirty years, a perturbation of climate, of which late spring-frosts, formerly unknown in the country, are among the saddest effects. A similar remark may be made in the plains of Alsace since the denudation of several of the crests of the Vosges.

TROPICAL FORESTS.

On the contrary, in countries within the tropics, where the nights are usually very serene, the radiating power of plants is sensibly increased, and the energy of other frigorific causes are developed in the same proportion, so that the presence of forests tends uniformly to reduce the temperature. This fact was proved by numerous observations given in M. Boussingault's work on the region included between the eleventh degree of north and fifth degree of south latitude, and it effectually explains the reason why America is not so hot as Africa within these latitudes.

The action of forests upon rain-fall, through the influence which they exert upon the temperature, is therefore very difficult to determine in our country; but it is distinctly marked in warm climates, as proved by numberless examples. M. Boussingault reports that in the region comprised between the Bay of Cupica and the Gulf of Guayaquil, a district covered with immense forests, *the rains are almost continual*, and that the mean temperature of this humid country is scarcely above 26^{c} Centigrade, (79° F.) M. Blanqui, in his travels in Bulgaria, mentions that at Malta the rains have become so seldom, since the trees have been cut away to make room for cotton, that at the time of his visit in October, 1841, not a drop of rain had fallen during three years. The fearful dryness which has desolated the Cape Verde Islands may be in like manner attributed to the cutting off of forests. On the island of St. Helena, where the wooded surface has considerably increased within the last few years, they observe that the amount of rain increases in the same proportion, and it is now double that which fell annually at the time of Napoleon's sojourn there. Lastly, in Egypt the recent plantations have brought rains where they were almost unknown before.

In the midst of this uncertainty in which our climate is left, by the study of meteorology—for the hygrometrical operations made at different points in France have yielded results too diverse to serve as the foundation of any theory—we will come to limit our study of the action of forests to the regulation of the water-courses in the single point of view which their mechanical and physical laws present.

RAINS, HOW DISPOSED OF IN FORESTS.

The rains which fall upon our continents are disposed of as follows: A part runs from the surface into the streams that carry it back to the sea. Another part is evaporated soon after its fall and returns to the atmosphere; and another part is absorbed by the ground. The first and third of these exclusively go to feed the springs and rivers, while the second is wholly withdrawn from our calculation. This feeding of the water-courses is more or less regular or constant according as it finds a superficial or under-ground passage-way, and therefore depends not only upon the physical properties and the topographical contours of the soil, but also upon the vegetation with which it is covered.

Under ordinary circumstances the superficial flow produces no effect except upon soil where the slope is considerable and quite impervious to the water, such as denuded rock or compact clay. It contributes only in a very irregular manner to the feeding of rivers and streams, as it delivers considerable volumes at certain times, and becomes nothing as soon as the rain ceases. But, on the contrary, when the soil is permeable, it absorbs all the water that falls, and does not deliver it again at the surface until some days after the rain, if completely absorbed. It is then that the action of forests begins to be felt. But if in fact the soil is uncovered the liquid volume descends with a velocity proportionate to the slope and brings with it the materials of every kind that obstruct its course, at the same time increasing its volume and destructive power. If these form torrents of limited ravage when the rain-fall is local, upon their banks or do business upon their waters. The forests, from whence their affluents proceed, are not merely private property, but belong in some measure to all of these persons. Those living in the upper country might justly complain of obstructions barring commerce from

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they become fearful inundation when it is more general in extent. But, on the contrary, if the soil is covered with woods the flow is more gentle. Being arrested at every point, broken by the trees, their branches, and the mosses which it encounter on the way, the water arrives at the bottom of the valley much slower, without erosions, and without bringing with it any foreign substances. The forest, therefore' in hindering the delivery of the water, lessens the chances of engorgement.

EVAPORATION.

We know that evaporation is going on at all temperatures, with greater or less rapidity, whenever the surrounding air is not already saturated with moisture. All other things being equal, it is greater when the ground is cleared than when covered with forests, because the latter arrests the action of the winds and prevents the masses of air, when saturated, from being renewed, and keeps the temperature lower by shielding the surface from the sun's heat. In lessening the amount of water evaporated, it by so much increases the quantity that is absorbed. It is, moreover, needless to insist upon a fact which everybody knows—for no one can be ignorant of the fact—that the soil in the forest after a rain remains wet much longer than where the surface has been cleared.

Evaporation can only take place except when, at a given temperature, the air is not saturated with moisture. But the rains themselves prove that there is an excess of saturation in the air at the time, and therefore there can be no evaporation when it rains. They can, therefore, have no very serious influence upon inundations properly so called, and in this regard cleared lands present no advantage over others.

ABSORPTION.

A part of the water which falls is absorbed by the soil. Some of this is used by the vegetation and serves to carry into the tissues of plants their soluble mineral elements, and is then returned in a certain degree to the atmosphere by the exhalations of the leaves. Another portion filters slowly into the soil till it meets an impervious stratum, and then flows along this bed, following its undulations, until it appears at the surface in the form of springs, unless it is drawn down into the depths of the earth's crust. It is this part alone, which is absorbed by the earth, that feeds the springs and furnishes the aliment of rivers. Every cause which tends to increase, to its detriment, the evaporation or pure loss of water, or to augment the superficial flow, has to this extent an influence upon the regulation of the water-flow, and in this regard forests exercise a most important influence.

All soils are not equally permeable. Some, as in the oölitic formation, absorb nearly all the rain that falls upon their surface. Others, like the primary rocks and liasic soils, allow rain to penetrate only so far as they are covered with vegetable mold. It is implied, therefore, that these vegetable beds should be preserved at the highest points, since they tend to increase the subterranean contingent of a part of the water, which, without its presence, would flow off upon the surface. But forests serve marvellously the functions of fixing the soil upon the steepest slopes. There will be no need of conviction upon this point, to one who shall pass over the Alps or the Pyrenees, where every peasant knows that to consolidate the banks of the brooks that cross his field, and to prevent the gullying of the slopes of the roads, he has only to plant a few trees. Who does not, moreover, know the cohesive power of grass-turf in fostering the roots of plants? The forests are turf upon a large scale, in which the blades of herbage are replaced by trees, of which the roots strike two or three yards into the soil. They can, therefore, oppose an invincible resistance to this washing away of the soil. According to M. Brougniart, the roots of trees contribute to augment the permeability of certain soils by offering a kind of vertical drainage.

CLAY SOILS.

Nor is this all. When the soil is carried away it confines a certain proportion of clay' which, when moistened to a depth which, according to M. Becquerel,[1] does not exceed six times the depth of the sheet of falling water, it forms a natural cup, its pores being obstructed mechanically by the rains which harden them. It is then impermeable, and free to deliver, by superficial flow, all the liquid that has not been absorbed. But when, on the contrary, the surface is covered with forests, the dome of foliage breaks the force of the rains, which only reach the soil in a state of minute division, and this impervious condition cannot then take place to hinder effective absorption the mouth of their river, while those in the low-land regions might with equal justice insist that their common property should not be injured by causes tending to dry up the sources of their wealth, or to deluge their fields with sudden inundations. If these rivers are navigable

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[1] Du climat et de l'influence qu'exercent les sols boisés et non boisés, par M. Becquerel, 1853.

Finally, by the humus which they produce, forests increase the absorbent qualities of different soils, and consequently the amount of liquids with which they may be charged. This absorbent quality is about twenty-five per cent. in weight in sandy soils, and varies from fifty to ninety per cent. for argillaceous soils, and in humus it raises to one hundred and ninety per cent.

"We must admit," says M. Hun,[1] "that the sheet of water produced by the heaviest rains scarcely exceeds a decimeter (3.9 inches) in depth. But the bed of soil in a well-stocked forest comprises a layer of humus over a great part of the surface of more than double this depth. In speaking of forests, I do not refer to the thin and ruined woods to which this name has been improperly applied; but to timber-lands like the forests belonging to the state, and to all the communal forests in the eastern departments, where the soil has a capacity for absorption greater than the volume of water yielded by the heaviest showers. From this we may explain the fact that after a deluging rain, the water-courses issuing from a well-stocked forest show only a moderate increase in their volume, and that they keep this up for quite a time, their transparency being scarcely affected."

GENERAL CONCLUSIONS.

Thus, to resume our subject, forests hinder the superficial flow or delay its progress; they hinder evaporation, and in a rain of given amount they tend to increase the portion that is absorbed by the soil and to diminish the surplus flow, which is lost without profit.

The data of the problem being stated, it is easy to adduce the conclusions. If we assume that the mean annual number of rainy days is 120 and of dry days 244, it follows that, in order that the rivers shall always keep at a constant level, the time required for the flow of their waters should be nearly three times greater than that in which they fell as rain. It would be necessary, therefore, that they should be stored in a reservoir of which the outlet should only be one-third as great as the inlet, thus allowing the waters to escape in a time three times as long as that in which they were received. If the flow takes place more rapidly, the reservoir will be dry for a season, after having flowed in excessive abundance, which might cause either a local or a general inundation. If, on the contrary, the flow is not so fast, it will not discharge in a proper time all the liquid mass, and there will be an engorgement, producing marshes and finally inundations. Thus an undue excess of rapidity or of slowness in the discharge of rain-water will cause, as we shall hereafter see, either from the absence or from an extreme abundance of forests, the same results.

FORESTS RETARD THE FLOW OF WATERS.

Forests, by favoring absorption, allow only the minimum of waters to be liberated. Moreover, in prolonging the discharge of the liquid absorbed, they extend the time required for its flowing off, and serve like a reservoir, of which the springs are the outlets, and thus insure the regular feeding of the water-courses. Denuded soil, on the contrary, allows a part of this water to escape both by evaporation and by superficial flow, retaining only imperfectly what it absorbs, and allows the sun's rays to pump up the moisture from the lower beds. For these reasons the springs become dry in summer and the rivers engorged in winter.

SAINT HELENA—ASCENSION ISLAND.

Among the numerous facts that prove this influence of forests upon the formation of springs and the regulation of water-courses, we are led to cite the following, which appears to us to be characteristic: "When Napoleon was taken to Saint Helena," says M. Blanqui,[2] "the English felt the necessity of occupying Ascension Island, which was then only a barren rock, scarcely covered with a few cryptogamic plants, and there they stationed a company of a hundred men. At the end of ten years this little garrison had been enabled, by dint of perseverance and plantations, to create a soil on the island, and from this to draw some water. It was abundantly planted with vegetables. Such was the result of plantation upon a rock in mid-ocean!"

EXAMPLES NEAR AT HOME.

But why should we seek so far away for the proofs of phenomena that are renewed daily under our eyes, and of which any Parisian may convince himself without venturfrom the sea, they become a highway of commerce with other nations, who might in reason join in the protest against any impairment of these rights.

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[1] Des inondations et des moyens de les prévenir, par M. Hun, conservateur des forêts.

[2] Voyage en Bulgare.

If these duties are pointed out and the obligation clearly shown, it

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ing beyond the Bois de Boulogne or the forest of Meudon? Let him walk out, after some days of rain, along the Chevreuse road, bordered on the right by the forest of Meudon and on the left by cultivated fields. The amount of rain that has fallen is the same on both sides, and yet the ditches by the roadside along the edge of the forest will be still filled with water, proving the infiltration going on from the wooded soil, while already for some time those on the other side, adjoining the cleared fields, will have been dry, after having served their purpose by a sudden flow. The ditch on the left will have emptied itself in a few hours of all the water, which the one on the right will take some days to convey to the bottom of the valley.

DIRECT EFFECT OF FORESTS ILLUSTRATED.

To these examples we may add another which appears to us to be characteristic. It is due to the observations of M. Cantegril, sub-inspector of forests, and was communicated by him to the *Ami des Sciences*. (December 11, 1859.)

"Upon the territory of the commune of Labruguière (Tarn) there is a forest of 1,834 hectares, (4,524 acres,) known as the forest of Montant, and owned by the commune. It extends northward on the Montagne-Noire, and the soil is granitic, with a maximum altitude of 1,243 meters, and a slope of from 15 to 60 in 100. A little water-course, the Caunan brook, rises in this forest and drains the waters of two-thirds of its surface. At the entrance of the forest, and along this brook, will be found several fulling mills, each requiring eight horse-power, and moved by water-wheels which work the beaters of the machines.

"The commune of Labruguière had long been noted for its opposition to the forest regulations, and the cutting of wood, together with the abuse of pasturage, had converted the forest into an immense waste, so that this great property would hardly pay the cost of guarding it and afford a meager supply of wood for its inhabitants.

"While the forest was thus ruined and the soil denuded, the waters after each heavy rain swept down through the valley, bringing with them great quantities of gravel, the *débris* of which still encumbers the channel of this stream. The violence of these floods was sometimes so great that they were compelled to stop the machines for some time. But in the summer time another inconvenience made its appearance. Little by little the drouth extended, the flow of waters became insignificant, the mills stood idle, or could be run only occasionally for a short time.

"About 1840, the municipal authorities began to inform their population relative to their true interests, and under the protection of a better supervision the work of replanting has been well managed, and the forest is to-day in successful growth.

"In proportion as the replanting progressed, the precarious use of the mills ceased, and the regulation of the water-courses was totally modified. They now no longer swelled into sudden and violent floods, compelling the machines to stop, but the rise did not begin until six or eight hours after the rains began. They rose steadily to their maximum, and then subsided in the same manner. In short, they were no longer obliged to stop work, and the waters were always enough to run two machines, and sometimes three.

"This example is remarkable in this, that all the other circumstances had remained the same, and therefore we could only attribute to the reforesting the changes that occurred, namely, diminution of the flood at the time of rain, and an increase in its flow during common times."

We may readily, from the preceding, account for the part which forests act in heavy and long-continued rains as to the floods then produced. Before reaching the soil and being completely absorbed, the rain must pass through the dome of verdure formed by the leaves, which they wet, thus causing the first appropriation of the waters. Then we must add the results of great permeability of wooded soil, and the great absorption of which the humus of forests is capable, so that until these demands are supplied no water can run from the surface.

The flow will be slower and with less destructive force than in cleared fields, on account of the obstacles of every kind which the liquid mass meets in its course, so that it will not reach the bottom of the valley until after the rain which fell in the lower parts shall have been discharged.

REVIEW OF M. VALLÈS' BOOK.

In a very remarkable work entitled "*Étude sur les inondations, leurs causes et leurs effets*," published in 1857, M. Vallès, an engineer of *ponts et chaussées*, contradicts the efficacy of reforesting as a means of preventing inundations. In giving an account of this work in the *Annales forestiéres*, (December, 1857,) M. A. F. d'Héricourt combats these becomes in one sense a national crime to neglect or evade them. In short, if the destruction of forests by those living about the head-waters of a river abridges the rights of those living below, it comes within the province of government to restrain them.

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assertions in a victorious manner, and proves conclusively that the reforesting of a portion of the upper basin of the Loire would have prevented the inundation of 1846.

"Accepting," says he, "the data of M. Vallès, who has analyzed with much care the various phenomena which characterized the flood of October, 1846, in the upper basin of the Loire, I will admit with him, that if we could have held back 175,000,000 cubic meters of water, the inundation which proved so sad a calamity to France would not have presented so painful an event. The upper basin of the Loire, as far as Roanne, comprises an area of 640,000 hectares, (158,080,000 acres,) of which at least a third, say 213,000 hectares, (52,693,000 acres,) might be profitably reforested. This inundation was caused by a rain which lasted sixty hours, and poured upon the soil a sheet of water 153 millimeters (about 6 inches) in depth. This portion of the basin of the Loire, therefore, received 979,200,000 cubic meters of water. On the hypothesis of M. Vallès, 244,800,000 cubic meters were absorbed. There accordingly remained for superficial flow, 734,400,000 cubic meters.

"But let us suppose that, in 1846, the 213,000 hectares above-mentioned to have been covered with massive woods, and then let us calculate what would have happened. These 213,000 meters would have received, as their share, 220,000 cubic meters. The absorbent qualities of the soil are increased 40 per cent. by reforesting, and this operation would have withdrawn 130,116,000 cubic meters from the superficial flow, which would have reduced the amount upon the retimbered portions to 195,174,000 cubic metres. But this liquid mass would have been hindered in its course down the valley, as we have above explained, by the passive resistances of every kind which the forest presents, and a half, at least, would not have arrived until after the other half, which had fallen in other portions of the basin, had passed off. We may, therefore, conclude that the superficial flow would not have exceeded 500,000 cubic meters, and that the calamities occasioned by the inundation of 1846 would have been completely prevented by reforesting.' "(*Les inondations et le livre de M. Vallès; par M. A. F. Héricourt. Annales forestières, décembre* 1857.)

SNOWS RETARD THE FLOW OF WATERS.

This hinderance in the flow is very apparent at a time when the snow is on the ground. When a part of a valley is wooded, the snows that fall there lie much longer than in other parts, and while diluvial rains, which ordinarily cause inundations, would be quickly followed by a rise of waters in the cleared region, and suddenly augment the liquid mass in that portion, the same rains would affect but slowly the snows that lie in the wooded portions. The swell would come by slow degrees, and the flood would give no special cause of alarm.

MOUNTAIN TORRENTS.

But it is especially upon mountains formed of slaty or marly rock that the utility o forests is shown in a remarkable degree. When the slopes of these lands, which have but slight powers of resistance, are denuded, the rains wear them into ravines with the greatest facility, forming partial excavations which extend from below upward, and end by forming a vast ravine, into which the lateral rills enter, and which are themselves ramified in every direction. At every shower the waters plunge from every part of the mountain into the channels they have worn, producing a torrent that brings down with it masses of rock and scatters them over the plains. When the slopes are wooded nothing of this kind can happen, for the trees protect the soil from the shock of the flood, and by retaining it with their roots they guard it against erosions. They, moreover, break up the waters and hinder them from flowing too rapidly toward the valley, and thus, by this double effect, they oppose an invincible obstacle to the formation of these devastating torrents. The most effectual obstacle that can be opposed to these inundations is, therefore, reforesting, and of all preventive measures this is the cheapest, besides offering, above all others, the inestimable advantage of maintaining and of multiplying itself. We need not think that these effects will require a long time to be felt, for it is not necessary to wait until the woods have come to their full size, and in four or five years their effects will begin to be observed. Every replanting on these slopes or plateaux is, in some degree, a conquest over the dominion of the floods, and a reduction of the ravages that they may commit.

FORESTS IN EXCESS.

But, carried to too great an extent, this operation will work precisely against the end which we desire to obtain. If the forests cover too great an extent of country, we

MONEY-PROFITS OF AGRICULTURE FROM THE SHELTER OF FORESTS.

Many thousands of our young and middle-aged men will remember with gratitude the shelter afforded by woodlands while in camp or bivouac during the late war, and every military commander fully under-

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may fear that the springs or subterranean water-courses may not be able to deliver all the rain that falls in a given time before other rains fall, which will cover the country with stagnant water. This was the condition of Gaul at the time when it was covered with forests, and such is still the condition of certain parts of America, which are wooded in this excessive degree. By this means we explain the apparent contradictions with which the partisans of reforesting are accused.

REFORESTING WHERE NEEDED.

It will be necessary, before coming to the desirable conclusion as to where the true proportion lies, and which cannot now be known with precision, that we should be able to show for each river-basin how much of a reservoir a forest should furnish that shall discharge, freely and with regularity, the rains that it receives only at intervals. However the case may be, it is evident that the reforesting should be carried on upon the mountainous parts of the different basins. It is there, practically, that the humid winds condense the vapors which they contain, on account of the lower temperature which there prevails, and from thence comes the superficial flow of waters, the absorption of which we wish to increase and make to appear in the springs, whose number and volume we would regulate. It is from thence, in short, the torrents begin which become the forerunners of the inundations, which it is our wish, if possible, to control.

CERTAIN CHANGES BEYOND OUR CONTROL.

It may be asked as to whether, these investigations being ended, "shall we always be able to guard against these inundations?" Probably not; for it is not in the power of man to prevent atmospheric perturbations, and we have never yet found the remedies against the return at times of the warm and humid currents of air from the Atlantic to which these diluvial rains are due which cause these damages. But at least, if we do not by reforesting entirely allay these evils, we may, peradventure, considerably reduce their magnitude, and enhance the efficacy of other means of defense which have until now been held as quite illusory.

DIKES AND OTHER STRUCTURES.

At the present time most of the works constructed for the preventing of these evils, in fact only increase them. It is held by a great number of engineers that transverse dikes, in order to be of service, should be built in the lower parts of the valleys and near the mouths of affluents; but the first result of this would be to cause inundations in these parts which are usually fertile and well cultivated, and where, if they had not been built, they might not have been felt. We might have to pay damages for the property injured, and the sums, although considerable, would not always be compensated for by the advantages claimed. This system, moreover, amounts only to transferring the evil to another place without escaping it, and it is at best but a secondary, not a radical, remedy. As for longitudinal dikes, not only are they frequently unable to withstand, in time of flood, the power of the waters, but they tend to erode the river-bed, and to create obstacles which stop the materials carried down. Rivers, therefore, become for the country which they traverse a permanent source of danger, for by a moderate flood the plains are often overflowed. Reforesting quite removes this peril, and by hindering the erosion of torrents they check the wearing out of the channels of the rivers and the obstructions at their mouths from accumulations of sand and gravel. They also tend to favor the construction of longitudinal dikes at points where their utility is recognized.

ALLUVIAL SEDIMENTS.

To some persons, it is true, the wearing away of mountains is rather a blessing than an evil, where the fertilizing mud is brought down and deposited on the inundated plains below; and instead of placing obstacles to this transportation by the waters, they might wish to favor its increase by every means possible. Our rivers thus distribute over the plains, during their flood, treasures such as the Nile brings annually to Egypt, and which have been so highly valued that that river has been ranked as divine. But unhappily we forget that if our rivers sometimes deposit a fertilizing mud, they are oftener loaded with sand and gravel that sterilize and lay waste. The floods of the Nile are so beneficient, because they return periodically at certain seasons, when the tropical rains have swelled the Heaven-favored waters of the great river, of which they furnish the supply. But with us the inundations come at irregular stands the value of forests as a protection, both to men and animals, against the heats of summer and the chilling winds of winter.

But from a nobler point of view, because it relates to the permanent welfare of the whole country through all time, the protection of belts of timber to farm-stock and to fields of grain is of the highest pecuniary

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times, and often when the fields are still covered with the harvest. Go, then, and persuade, if you can, the peasantry of Berré or of Provence to adore with gratitude the waters along the desolated banks of the Loire and the Rhone, which have swept away the labors of years, and covered their poor heritage with gravel-beds! Moreover, the mud of the Nile is brought down from the mountains of Central Africa, still, so far as we know, but slightly inhabited, and whose population might little object to the privation of this fertile element. But is this so with us? In robbing the mountains of the little vegetable earth with which they are covered to fertilize, at their expense, a few privileged points, is only to augment the riches of a wealthy country by impoverishing the poor! (*Claré.*)

OPINIONS OF SIR CHARLES LYELL.

Sir Charles Lyell, in noticing the conservative influence of vegetation in retarding the leveling effects of running water, says: "It is well known that a covering of herbage and shrubs may protect a loose soil from being carried away by rain, or even by the ordinary action of a river, and may prevent hills of loose sand from being blown away by the winds, for the roots bind together the separate particles into a firm mass, and the leaves intercept the rain-water, so that it dries up gradually instead of flowing off in a mass and with great velocity. The old Italian hydrographers make frequent mention of the increased degradation which has followed the clearing away of natural woods in several parts of Italy. A remarkable example was afforded in the Upper Val d'Arno, in Tuscany, on the removal of the woods clothing the steep declivities of the hills by which that valley is bounded. When the ancient forest-laws were abolished by the Grand Duke Joseph, during the last century, a considerable tract of surface in the Cassentina (the Clausentinum of the Romans) was denuded, and immediately the quantity of sand and soil washed down into the Arno increased enormously. Frisi, alluding to such occurrences, observes, that as soon as the bushes and plants were removed the waters flowed off more rapidly, and, in the manner of floods, swept away the vegetable soil." (*Treatise on Rivers and Torrents*, p. 5; Garston's translation.)

"This effect of vegetation is of high interest to the geologist when he is considering the formation of those valleys which have been principally due to the action of rivers. The spaces intervening between valleys, whether they be flat or ridgy, when covered with vegetation, may scarcely undergo the slightest waste, as the surface may be protected by the green sward of grass; and this may be renewed in the manner before described, from elements derived from rain-water and the atmosphere. Hence, while the river is continually bearing down matter in the alluvial plain, and undermining the cliffs on each side of every valley, the height of the intervening rising grounds may remain stationary." * * * * * * * *

DENUDING POWER OF RAINS IN SPAIN.

"During a tour in Spain in 1830, I was surprised to see a district of gently undulating ground in Catalonia, consisting of red and gray sandstone, and, in some parts, of red marl, almost entirely denuded of herbage; while the roots of the pines, holm oaks, and some other trees, were half exposed, as if the soil had been washed away by a flood. Such is the state of the forests, for example, between Oristo and Vich, and near San Lorenzo. But, being overtaken by a violent thunder-storm, in the month of August, I saw the whole surface—even the highest levels of some flat-topped hills—streaming with mud, while on every declivity the devastation of torrents was terrific. The peculiarities in the physiognomy of the district were at once explained, and I was taught that in speculating on the greater effects which the direct action of rain may once have produced on the surface of certain parts of England, we need not revert to periods when the heat of the climate was *tropical*.

"In the torrid zone the degradation of land is generally more rapid, but the waste is by no means proportioned to the superior quantity of rain or the suddenness of its fall, the transporting power of water being counteracted by a greater luxuriance of vegetation. A geologist, who is no stranger to tropical countries, observes that the softer rocks would speedily be washed away in such regions if the numerous roots of plants were not matted together in such a manner as to produce considerable resistance to the destructive power of the rains. The parasitical and creeping plants also entwine in every possible direction, so as to render the forests nearly impervious, and the trees possess forms and leaves best calculated to shoot off the heavy rains, which, when they have thus been broken in their fall, are quickly absorbed by the ground beneath, or, interest to the grazier and the farmer as well as to the gardener and the fruit-grower.

An eminent English writer,* in speaking of this subject, says:

> When plantations and strips of wood of considerable extent are so arranged as to obstruct the wind in its course, shelter is afforded both to cultivated and pasture land, and in appearance as well as in productiveness the character of the estate undergoes a thorough change.
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> It cannot be doubted, by any one acquainted with the losses which are frequently sustained on high-lying farms from nipping frosts and withering winds, that in cold, late districts shelter is of the greatest value to the farmer. Various kinds of crops are liable at the time of flowering to be seriously injured if exposed to strong winds, and frequently cereal crops which are just beginning to ripen suddenly assume a premature whiteness after being loosened about the roots by severe wind-storms; the crop is imperfectly developed, and the farmer is the loser. Shelter will to a very large extent prevent this evil. Then, at harvest, it has been found that a line of plantations running transverse to the wind, though at the distance of half a mile, has materially diminished the loss from shedding. Along the eastern coast of Great Britain a proper increase of shelter would not fail to add several bushels of grain to the yield per acre; and in Caithness and Orkney, where, simply from the want of shelter at first, ordinary timber-trees rarely ever become more than stinted bushes, the increase would be a great deal more.
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> The only way in which either forest or hedge plants can be started into growth in these northern countries is to afford them at once the shelter of a stone wall or earth embankment, and often when their tops appear above the upper surface of the protecting dike they are cut over by the winds as by a knife. This shows in its extreme aspect the importance of that shelter which, in all exposed situations, must in a greater or less degree promote the development of crops.
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> The value of shelter for pasture-stock is no less deserving of careful consideration. It is well known to veterinary practitioners that cattle grazing in high and exposed situations are generally more predisposed to consumptive and cutaneous diseases than animals pastured on low and sheltered farms. In cold, backward springs the shelter conferred even by a very small plantation is to the sheep-farmer in the highland districts of the greatest practical service. On grazings much exposed to withering winds the large number of lambs deserted by their mothers in late seasons in consequence of a scarcity of milk is sometimes a severe loss to the flock-master. But it is well known that on hill-farms partially sheltered by growing timber the percentage of deaths from this cause is considerably reduced. The pasturage, when sheltered even in a very partial manner, is both earlier and more nutritive than if exposed to the full effects of unchecked winds, and in their haunts flocks rarely fail to indicate the situations which are really benefited by plantations, either near at hand or at a considerable distance. It is a well-known principle of animal nutrition that the radiation of heat from the system is greater in a cold than in a warm temperature, and that more food is necessary in the former situation than in the latter to maintain vital heat. If it is practicable, therefore, in the formation of plantations to elevate the mean temperature of any particular district two or three degrees, it follows that its grazing will not only be improved, but that, in proportion consumed, fattening animals will make greater progress than under less favorable circumstances.
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> It appears conclusive, therefore, that the relation that exists between forestry and agriculture is a very intimate one; and yet while great exertions are being made to develop the agricultural resources of the country, the inactivity which has long prevailed in respect to the management of timber continues the same, and presents, in some respects, an aspect hopeless enough.

ENHANCED VALUE OF FARMS FROM TREE-PLANTING.

The writer just quoted * thus aptly represents the profits to be derived from renting or selling estates suitably shaded with woodland:

> In almost every instance in which a farm is to be let on lease the offerers are influenced, in a greater degree than they themselves are aware of, by the first general ap-

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when thrown into the drainage-depressions, give rise to furious torrents. (*De la Beche, Geol. Manual*, p. 184, 1st ed. *Lyell's Principles of Geology*, 8th ed., Lond., 1850, p. 690.)

MARSH'S MAN AND NATURE.

The work entitled "Man and Nature," written by the Hon. George P. Marsh, our present envoy extraordinary and minister plenipotentiary to Italy, abounds in examples supported by high authorities bearing on this subject. It is understood that a new edition of this work, with additional facts, is in course of publication.

* Morton's "Resources of Estates," London, 1858.

pearance which it presents. If the exposed parts are partially under thriving, well-inclosed wood, the whole fields, within the range of vision, have such a look of warmth and fertility about them that, as if by intuition, a few shillings more per acre are put upon the land than would otherwise have been given. The amenity and value of landed property are so linked together that in ordinary cases the one cannot be increased without a greater or less addition being made to the other also. It has been proved by experience that in proportion as well-laid-out plantations are extended on an estate up to but not beyond a certain point, the yearly value of its farms advance. I know property which eighty years ago did not yield more than half the rental derived from it now. It was then, according to the testimony of old men in the district, little more than an open waste; but the proprietor began about then to plant extensively, and as the plantations increased in number and age the rental of the estate advanced with them, though the farm was anything but good. With right management the same result may be expected on every exposed property.

We have in mind a farm the owner of which some twenty years ago planted a row of maple-trees entirely around the boundary-line, and on each side of the road that passed through it. As seen from a hill at a little distance, these trees give a decidedly cheerful aspect to the land, and have added several dollars an acre to its cash value.

INSALUBRITY CAUSED BY NEGLECT OF AGRICULTURE; THE SALUBRIOUS INFLUENCE OF TREES.

In a warm climate an excess of vegetation, neglected and allowed to decay on the ground, will, as is well known, breed pestilence of such virulence that it is not always limited to the locality where it originates, but spreads far beyond these limits, and sweeping off its hundreds of victims wherever exposure to the contagion and favoring circumstances carry it. Within the past year the fearful ravages of disease at Memphis and at Shreveport have painfully renewed the memories of still more fearful calamities caused in former times by neglect of sanitary conditions or unwise exposure to malarious exhalations.

In certain cases, as in the Maremma of Tuscany, and the Pontine marshes near Rome, in a climate corresponding to portions of our own country, and under circumstances that may in future produce like results with us, we see extensive tracts given up for centuries to the destructive reign of malaria, and only of late has any effectual remedy been attempted with reasonable prospect of success. So firmly, however, has the evil been planted that many years of patient industry, guided by the best lights of modern science, and vast sums of money, will be required to win back the lost favors of nature, and restore these regions to that prosperity they once enjoyed.*

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* The examples we have quoted are of such practical value as a warning to us not to neglect the causes which produced them, that we deem it proper to quote from an article printed in the American Journal of Science and Arts, in 1830, a vivid description of them:

"MAREMMA OF TUSCANY.

"The Maremma of Tuscany extends from the south border of the vale of Arno to the States of the Church, and from the Appenines to the sea-shore on the west. It was anciently covered with a busy race of men, high in rank among heroes and sages; but although its soils and seasons were then the same as now, the insalubrious elements were probably kept in comparative subordination. Maremma signifies the region of malaria, and this Maremma has been cited as a proof that marsh effluvia cannot be the source of malarious fevers, because this tract is nearly depopulated by the diseases attributed to that cause, although it is an undulating upland country of volcanic origin. But, perhaps it will be esteemed conclusive evidence that science has discovered the lurking places of this poison, and that it conceals itself at times in spots remote from the shaking morass and mangrove sea-beach, although those are its legitimate places of abode. In the valleys of this deserted tract there are a few scattered houses, and the inmates, pale and languid, appear to maintain but a feeble conflict with the destroyer. On the hills are seen occasionally ruins of moldering towns and ancient

Among the remedies for preventing the spread of malarious emanations, and counteracting their influence, are belts of timber planted along the borders of these pestilential marshes. Much has been lately said of the wonderful influence of several species of the *Eucalyptus*, or

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towers. 'Above all the rest rises the eminence on which the aged walls of Voltera repose. Its inhabitants wander like shades among its majestic ruins, and do not attempt to preserve even their own habitations; but abandon them to the elements, and await with resignation the returns of the scourge which decimates them every year.' Some time in the sixteenth century a sweeping pestilence cut off from this whole region a great part of the population; after which the price of property declined, and the lands fell into possession of the great capitalists. 'From this time all productive activity was banished;' and although Leopold, Duke of Tuscany, made several attempts to plant colonies in the Maremma, they were each unsuccessful, because the colonists died of the fever before a settlement could be established. Thus the remains of a people who were distinguished among the Volsci and Arretinii as warriors, and who improved upon the science and taste of Greece and Tyre in the arts of peace, have gradually wasted away before the ravages of the pestilence. The genial climate allows the progress of vegetation through the winter, when multitudes of shepherds and herdsmen descend from the Appenines with their flocks and cattle to pasture on the spontaneous herbage; but during the summer companies of wild horses and herds of black cattle sweep over these immense pastures, reveling at will in the produce of the fields. The voices or the footsteps of men never interrupt these solitudes except in the ruined cities and an occasional hamlet in the valleys which shelter a few manufacturers of alabaster and alum. Even these employments are not followed from March to November. All is resigned to the dominions of malaria, which 'increases in proportion as the resistance of civilization diminishes.'

"PONTINE MARSHES.

"But it is in the States of the Church that this pestilence exercises its most hideous sway and spreads the darkest ruin. The lands are more fertile than the Maremma of Tuscany. Fig-trees and aloes grow among the ruins; vegetation is too luxuriant to be employed in pasturage. The eye cannot penetrate the depth of the majestic woods,[1] and the imagination peoples their gloom with the manes of that ancient people who formerly rendered these solitudes illustrious.

"When the papal throne was established at Avignon, in the beginning of the fourteenth century, Rome was given up to the most desperate factions. Nothing can surpass the misery occasioned by these civil wars. One ambitious family succeeded to another; one demagogue displaced another in such rapid succession that when Gregory XI returned to Rome in 1377 he found that the country was laid waste; that the suburbs had disappeared; that the walls in many places were broken down, and that the diminished and discouraged population had neither wish nor ability to return to the pursuits of industry; and from the period of this melancholy desolation, when the luxuriant gardens and fields, and the beautiful courts and pleasure-grounds in the city, and contiguous to it, had been for some time neglected, malaria commenced its frightful and gloomy reign. As a consequence upon these political animosities, estates were wrested from their owners, and fell in vast domains into the possession of individual proprietors. Thus, upon luxuriant soils and in places that had been pampered with the utmost efforts of culture, lazy weeds and thickets of herbage accumulated unthought of, sending forth pestilence, at once the 'cause and the consequence of the insalubrity of the atmosphere, banishing the rural population from the fields.' The sun shines here with the purest light; the softest airs woo the lingering and admiring passenger; the winds blow with the most exhilarating freshness; but all these advantages are turned to deadly agencies for the want of an enterprising, vigorous, industrious, and persevering population. Neglect creates what is equivalent to a marsh in every thicket of herbage, and the evil increases, and will increase, while there are no effective laborers, and while only a few ignorant, half savage, and decrepit herdsmen roam over the lands, haggard and trembling with the annual visitation of disease, 'possessing hardly spirit enough to ask strength from Heaven to resist the coming attack, or scarcely a wish to survive it.'

The celebrated plain which surrounds the city of Rome extends from the promontory of Circe to the hills of Etruria, thirty leagues in length by ten or twelve broad. The surface is uneven, but neither are the valleys deep nor the hills precipitous. The plain seems an immeasurable extent of turf, spotted with thorns and briers, and a few solitary post-houses on this deserted tract alone 'reveal to the traveler that he is apblue-gum, an Australian tree lately introduced and found to thrive well in the southern part of the United States. The results of observation upon this and other questions in which sanitary welfare depends upon the presence or absence of forests, would come within the range of inquiry proper for the commission we are recommending.

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[1] An excess of woodlands may prove as injurious to human industry and happiness as a deficiency of the former. It should be our highest aim to ascertain where this golden mean lies, and how it can be most effectually maintained.—H.

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proaching the city of Rome.' There is no example of so rapid a depopulation as that which now wastes this imperial city, unless by siege, or by some elemental catastrophe. This is owing as well to political as to physical causes, but the proximate cause is malaria. So late as 1791, the city contained 166,000 inhabitants. 'The streets,' says M. Chateauvieux, 'at that time were filled with sumptuous equipages and liveries, and decorated with magnificent palaces. In 1812 I entered the city by the same road, but, instead of equipages, it was filled with droves of cattle, goats, and wild horses, which a number of Tartar-looking horsemen, armed with lances and wrapped in cloaks, were driving before them. These seek an asylum within the walls of Rome from the fate that awaits them in the fields.' The population of the city has diminished more than sixty thousand in twenty years, and of the one hundred thousand who remain, ten thousand are vine-dressers and herdsmen, who have fled before the pestilence from their habitations in the country. The deadly influence advances every year, invading some new section or square, and every year its terrible effects are augmented; for as it 'increases in the inverse ratio of the resistance occasioned by the population, the fewer inhabitants the more victims.' Some parts of the city contain more dwellings than inhabitants, consequently no repairs are made; stairs, doors, roofs, and windows fall, but are not replaced; the occupants remove to other dwellings; abandoned palaces frown in gloomy grandeur, and multitudes of convents are uninhabitable, and left even without a porter to take care of them. It is here seen that the pestilence walks in the footsteps of receding industry, wherever its effectual resistance is withdrawn, while the remains of civilization and culture furnish aliment and stimulus to the insalubrious exhalations. The deep, weedy dells, and the rank herbage around the moldering ruins, supply these pestilential materials, from which the sun and airs of Italy extract swift poisons, and from which every breeze comes freighted with the messengers of death.

"ATTEMPTS TO RECLAIM THE PONTINE MARSHES.

"These obvious proximate causes are in full operation over the Pontine marsh. The attempt to reclaim it does honor to the pontificate of Pius Sixth; but although twenty miles have been restored on the Appian way, where three feet of alluvial marsh had formed above the pavements, and although the reclaimed lands are more productive than those of almost any other country, yet so immense a tract (more than a hundred miles) remains that the enterprise will probably fail under the present nerveless government, especially as the disease is fatal to the workmen except for a short time in winter. So successful, however, are the efforts of the French engineers, under the protection of Pius, that not a doubt remains that the whole spongy morass, now covered with reeds and the hoary water-willow, might be restored to cultivation; that the pestilential influences might be eradicated, and a healthful population be made to rise near its fertile valleys like that which distinguished the days of the republic. Those parts which have been but partially drained are represented as more rich and beautiful than the Elysium of the poets; but the charms of a fragrant atmosphere, the effulgence of an unclouded sun moderated by bowers of foliage, the rich verdure checkered by flowers of every hue, the clustering vine and loaded fig-tree, invite the passenger to linger in the scene of enchantment only that a deadly poison may insinuate itself into his veins. Near the sea, on the west of the Via Appia, is a garden of Prince Doria, the flowers and trees of which have so long grown wild that the tangled shades form a receptacle of miasmata, and a deep, fertile valley, the property of Prince Chigi, shaded with elms, and possessing every variety of rural elegance and beauty, has long been abandoned to the dominion of nature and the seasons. Deer and birds are the only objects of moving life which disturb the frightful repose.

"These will suffice for examples of neglect, and will show how it is co-operating with natural causes to depopulate one of the fairest portions of the globe; and as like causes produce like effects, Rome, while gathering up her glories and her mighty deeds for the shroud, and passing to the silence and solitude of Paestum and Volterra, may alarm the inhabitants of other cities, and teach them to guard against the approach of similar dangers."—(*Am. Jour. of Science and Arts*, 1830, xvii, 318-322.)

See, also, *De Prony, Description hydrographique et historique des marais pontins. Relief du sol, cadastre, détails interieurs, analyse raisonnée des principaux projets proposés pour leur dessèchement*, etc., (with atlas in folio.) Paris, 1822. 4to.

As an evidence that like causes produce like results, we quote from an English work of high authority* the description of a parallel to the Maremma of Tuscany, as found in Northern India:

> In the valleys at the base of the great Himmalayan range in Northwestern India there are tracts of country which are lost to every useful purpose, from the waters by which they are traversed being altogether uncontrolled and unregulated. The consequence has been that these tracts, highly favored by nature in other respects, have been transformed into great, marshy, pestilential wastes, tenanted only by beasts of prey, and fatal, not solely to such human beings as pass through them—for no man can dwell there permanently—but by their malarious exhalations tainting the air for a considerable distance around them.

The writer here quoted had then (1852) recently visited the works of improvement that had been undertaken in Tuscany by the government for improving its sanitary and social condition. Two principal works had been devised. The first in the valley of the Chiana River, which, for a length of sixty miles and an average of about three, had been reduced to the most frightful state of unhealthiness and depopulated by malarious influence, and here the work had been finished with the most remarkable success, the entire valley being restored to a healthy condition and occupied by an industrious population; its low, marshy localities all filled up, and the waters under perfect control. The other work was the great lake or marsh of Castiglione, which, for centuries, had been a center of miasma, whence the whole adjoining country was infected. Here operations were still in active progress, and the good results, although promising fairly, had not yet been fully realized.

These instances may doubtless suggest parallels on a smaller scale, perhaps, but not less marked, to the minds of many who may read these pages. The deductions are obvious, and the whole subject worthy of most careful study.

EVILS RESULTING FROM AN EXCESS OF FORESTS.

There can be no doubt but that injuries may result, as well to agricultural interests as to the public health, from an excess of forest growth. In ancient Gaul the climate was very different from that of France as it is to-day. The fevers that prevailed in many sections of the country when covered with swamps disappeared when these swamps were drained. The decaying timber, when first exposed to the air, increased these prevailing diseases; but this cause of sickness disappeared when the decomposition became complete.

It is the highest aim of forestry to attain the golden mean between too much and too little, and on this due balance of field and grove depends that equilibrium of health and wealth that promises the greatest amount of human happiness to the greatest number, and through the longest period of time.

WANTON DESTRUCTION OF FORESTS IN FORMER TIMES.

Prof. David Low, of the University of Edinburgh, in his eminently practical work entitled "On Landed Property and the Economy of Estates," (1856,) in speaking of this subject, remarks:

> The cultivation of wood is a branch of rural industry which merits, in a high degree, the favor of the community and the attention of all who possess property in land. It appears to be the early aim of nature to clothe the surface of countries with trees. It

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* Italian Irrigation; a Report on the Agricultural Canals of Piedmont and Lombardy, addressed to the Honorable the Court of Directors of the East India Company. By R. Baird Smith, F. G. S. 2 vols., 8vo. London, 1852. I, p. 71.

is the aim of man, after a time, to cut down the forest, that he may clear a space for his labors and apply the timber to his uses. Every means is then taken to destroy, without a thought of preserving or renewing, and fire is added to the hatchet to destroy what ages have been employed to produce, and what ages would be required to restore. The ravages of the Roman soldiers among the forests of the conquered countries would exceed belief were they not attested by many records. It was not enough for them that military roads were formed to maintain their unjust dominion. They consumed the woods of the conquered countries by fire, that the inhabitants might be driven from their retreats. Thus immense tracts in this country were laid waste, and yet remain despoiled of the rich vegetation which they once afforded. Ireland, exempt from the Roman dominion, long remained a finely wooded country; but the forests were wasted by degrees, and the civil wars of another age completed their destruction. The last wolf of the Irish woods, we are told, was killed about the beginning of the last century, showing that the great forests of the verdant isle had then nearly reached their term. The beautiful island of Madeira, so named from its woods,* was, when discovered, an entire forest. The Portuguese settlers set all the woods on fire, and now scarcely a forest-tree remains in all the island. In the United States of America we all know the rapidity with which this kind of destruction proceeds. Besides the labors of the settlers, fires lighted by chance in the woods extend over immense tracts of country, and consume every growing tree.

PROFITS: PROFESSOR LOW ON THE PLANTING OF TREES.

But there is another and more cheering era in the history of the sylvan scene. This is when civilization has advanced, and man, under the safeguard of laws, sets about restoring the desolated forest. The cultivation of wood then becomes an art founded upon principles, and pursued for the gratification of taste, or for purposes of utility. The planter has been characterized as the most disinterested of men, because he labors for posterity. The claim of the planter to this distinction may be questioned, although he may enjoy the thought that the workmanship of his hands will not perish with him. Like every one who labors from choice, the planter experiences gratification in his pursuit. The little tree which he places in the ground quickly becomes a part of the landscape around; and thus the taste is gratified almost as soon as the work is done. In a few years more his woods yield shelter from the winds, and thus increase the value of the lands around, while it is rarely beyond the expectations of human life to look for a direct profit from the wood as it advances to maturity. To expend capital on planting, indeed, is merely to lay out a fund to increase at interest, and often at a high rate of interest. Let it be supposed that a wood requires sixty years to reach the age of good timber; that the land is worth 5*s.* per acre of yearly rent in its original state; and that the expense of planting and inclosing it is £5 per acre. Then, rating money at 5 per cent., and supposing it to increase at compound interest, the amount of £5, principal and interest, will be found by calculation to be for sixty years £93 7*s.* 11*d.*; and the amount of assumed yearly rent, 5*s.*, for the same period, £88 7*s.* 11*d.* So that, if the wood shall be worth £181 15*s.* 10*d.* at the end of sixty years, the original capital will have been laid out, and the loss of rent returned at 5 per cent. compound interest. But £181 15*s.* 10*d.* per acre, including the progressive thinnings, would be considered by planters as a low price of wood, even of the least valuable kinds, of sixty years' standing; and, therefore, it will be seen that wood may yield a high return on the capital expended. Planting, then, may be readily rendered the means, on the part of a landed proprietor, of setting aside a fund for any specific purpose, as for a provision for a family; and no man is deemed peculiarly disinterested who merely obeys a dictate of reason and humanity, and provides for his descendents. The planter, then, has his motives of rational interest to justify him in the opinion of those who look only to gain. He lays out his capital with a view to a profitable return. He improves the value of his estate, while, in the practice of his art, he finds the materials of an innocent recreation. It may be questioned whether, in the whole range of rural occupations, one more interesting pursuit presents itself than the superintendence of a growing wood, presenting to the eye at every season new objects of interest and solicitude. Where is the planter who would wish the workmanship of his hands undone, and who does not look with an honest pride on the beautiful creation which, with a generous spirit, he has raised up around him?

* * * The cultivating of trees, then, may without diminution of the gratification of taste be pursued as an economical art, involving considerations of profit. Even if the gratification of taste shall be mainly regarded in planting, still it must be held to be important, as the means for extending the culture of wood, that the object of desire shall be obtained at the least cost, and placed within the reach of the greatest number of persons. If, on the other hand, utility and profit shall be chiefly regarded, then, as in all the other branches of rural economy, the more simple and

economical the means are by which we are enabled to accomplish our purpose, the more perfect may our practice of the art be considered. Looking to planting as an economical art, it is not enough to produce timber any more than it would be to produce wheat, or barley, or rye. The labor and capital employed should be economized, and the highest return of produce derived, in order that the full measure of public and private benefit may be obtained. That, indeed, is not the true economy which looks merely to the saving of present expense without reference to the ultimate return, yet the saving of present expense is an important consideration in the planting of wood. One of the first inquiries of planters who design extensive works must generally be the pecuniary sacrifice required to effect the purpose. To enhance expense, then, is to lessen or take away the inducement to plant in many cases, and especially in the case of those more barren parts of the country, where the greatest profit is to be derived from wood; and when we reflect on the great importance of covering such parts of our island with so rich a produce, we must see how great the error would be in disregarding economy in the practice.

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* "*Madera*" sinifies timber or wood: "*Madera de construccion,*" ship-timber, &c.

PROFITS: OPINIONS OF MR. MORTON.

While the amenities and shelter afforded by plantations must necessarily, more or less, bear indirectly on the intrinsic value of landed property, it is mainly to the direct results obtainable from wood itself, viewed in the light of a regular crop, that attention is most frequently directed to it. The agricultural crops which yield the largest returns are usually preferred by the farmer; and, while it can be proved by facts and figures that wood is frequently in the end much more remunerative to the landlord than any other description of crop, the delay in returns from it must be the principal cause of its being grown only to a very limited extent. With land in request for farming purposes at £3 or £4 an acre of rent and upward, the profit that would be derived from a crop of wood in that case could scarcely be expected to be proportionately so great as on land of less agricultural value. No doubt fertile soils will produce more timber in a given time than poor soils, and will, in some instances, give even a return of £5 to £6 an acre per annum when under wood; but, if profit is the main design of planting, it is the steep, stony ravines and their poor lands, incapable of being profitably cultivated, that should be planted. On soils of this class a much higher annual return is often obtained from a crop of wood than could be realized in agricultural rents. Of course this will not be the case when a kind of timber has been planted which the soil is incapable of bringing to maturity; but a mistake of this nature will only occur when the skill and judgment of the planter have been at fault. It is, indeed, a matter of regret that, in numerous instances, errors of this kind are committed by incompetent foresters; but landed proprietors have themselves greatly to blame in requiring no higher standard of merit from those who are intrusted with the management of their plantations than that they should be able to handle the ax. To fit a man for the proper discharge of his duties as a forester, he would require, in addition to an extensive acquaintance with the practical developments of plantation management, to have a comprehensive knowledge of vegetable organography and physiology. The possession of these acquisitions implies an amount of education which should place the individual above the position of a mere worker; and, if it is only on large estates that such an officer can be employed, the occasional advice of some qualified professional man may serve a similar purpose on small properties.*

ECONOMY OF GROWING TIMBER TO FULL SIZE.

In the few places where timber-lands are kept for growing wood in the United States we believe it is customary to cut off the entire crop at intervals of thirty or forty years, more or less, and then leave the young shoots to spring up into another growth. This is a wasteful kind of arboriculture, as will be seen by a slight examination of the mathematical principles involved.

The timber of our country, with scarcely an exception, grows by the addition of a ring of new wood annually next to the bark. If we suppose these rings of growth to be true circles, and of equal width, their radii would be from year to year as follows:

1, 2, 3, 4, 5, 6, &c.—an arithmetical series.

The areas within these rings would be to each other as the squares of these radii, viz:

1, 4, 9, 16, 25, 36, &c.—a geometrical series.

The differences between these successive numbers would show the relative areas of the rings, or (if, for a given length, they could be separated and weighed) their value, and the numbers would be:

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*Resources of Estates.

1, 3, 5, 7, 9, 11, &c.—an arithmetical series;

of which the common difference is 2. In other words, a tree will grow three times as much in weight and value during the fifth year as it did in the second; three times as much in the eighth year as in the third, and so on, besides its increase in heighth. Furthermore, a large tree is more valuable than a small one, in proportion to its weight or solid contents, because it can be applied to more uses."[*]

There may be exceptions to this rule of growth, because in certain species the rate is more rapid in the earlier years. French writers on forestry have divided growing timber, as to its management, into the following classes:

Futaie is a full-grown wood in which the timber is all of the same age, and allowed to stand till of full maturity and value. It is then cut off in divisions or compartments, and the land again planted, it may be, with another species. This, by preference, is valued above all other methods, and is that used in the state forests of France, and recommended elsewhere, wherever practicable.

Taillis or coppice, is a spontaneous growth from the stumps or roots of other trees, and is cut off after a much shorter interval, yielding less wood, and of less value as to quality, but on private estates found sometimes more profitable to the owners, especially with the soft, rapidly-growing kinds most used for firewood, and in the smaller industries. A variety of this kind of culture, termed *taillis composé*, consists in leaving here and there certain promising trees to grow to their full stature and value. These add in many cases very largely to the profits of the forest, and this should be done whenever circumstances admit.

Jardinage is the cutting out annually from the forest such full-grown trees as may be found, leaving others to fill their places. The woodmen, in doing this, seek to save the young trees as much as possible, by lopping off the branches of the trees to be felled. With climbing spurs fastened to his legs, and with a rope and hatchet or saw, he climbs to the lowest limbs and cuts them off; thus proceeding toward the top, till his tree is simply like a mast, and without branches. In its fall it is then much less liable to injure itself or other trees. This method by *jardinage* is not recommended where the others can be practiced, as the forest is very liable to run out, and the soft, rapidly-growing kinds will be apt to get in and shade out the slower and more valuable growth. The rules of management in these several methods have been reduced to great accuracy, so that the professional forester in Europe is able to produce the greatest possible result from his labors. In first planting, the timber is much closer together than is for its good as it grows larger, so that a constant thinning out is necessary, while the more promising trees are trimmed and trained to the most vigorous and rapid growth possible.

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[*] There is a certain age of maturity in which each tree attains its greatest strength and durability. If cut down before that age, the tree is not only smaller, but contains a greater proportion of sap-wood, while the heart-wood is less strong and lasting. If allowed to grow too long, the center of the tree become either brittle or soft, and decay sets in. The following data are from Tredgold's tables: oak, age of maturity, 60 to 200 years—average, 100 years; ash, elm, and larch, age of maturity, 50 to 100 years; fir, age of maturity, 70 to 100 years.

The best season for felling timber is that during which the sap is *not* circulating—that is, in cold and temperate climates, *the winter*, and in tropical climates, the dry season; for the sap tends to decompose, and so cause a decay of the timber.—*Meade's Naval Construction*, p. 291.

Herein consists their great success, and in this kind of experience our American people have everything to learn. They should be enabled to judge of the adaptation of these various methods, not only as practiced in France but in Germany and other countries of Europe, where forestry has long been carefully studied as a science, and it would be a part of the duties of the proposed commissioner of forestry to condense and apply this information for our benefit, and to suggest such modifications as might appear best adapted to our circumstances. The ripest experience of the Old World would thus be made available, and our people would be able to reap the benefits of whatever there may be of merit in their methods, and which might thus be made generally known.*

EARLY RESERVATIONS OF TIMBER FOR SHIP-BUILDING.

The value of American timber for ship-building has been recognized in Europe from the earliest colonial period, and in some instances the collection and preparation of forest products was a principal motive in the founding of a settlement. Thus, in the reign of Queen Anne, a considerable number of German Palatinates were induced to settle on the Hudson, where the collection of turpentine and making of tar were original but fallacious motives with the government. Because devised without knowledge of the country and its resources, the experiment failed, and the emigrants found their proper place as agriculturists. Some of the conditions of early grants and charters, and the instructions of those sent out to put them under operation, are curious as illustrating the state of knowledge of the times, and as indicating the great value attached, even then, to these essential resources of commercial wealth and naval power. However designed, they proved in many instances oppressive, and may be reckoned among the causes of discontent that resulted in our American revolution. They were injudicious at the time, because the timber was then in excessive abundance, and the space it covered was really needed in part for agricultural use. When, therefore, for example, the agents of the "Surveyor-general of

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*Careful trimming will wonderfully promote the growth of wood, by preventing a waste of the vital energies of the tree upon parts that are useless or injurious to best results; and the writer of an anonymous popular book entitled "English Forests and Forest Trees," remarks, p. 302, that "more timber is lost by being too fearful of cutting down than by boldly thinning."

The following table shows the number of trees on such land as the forest of Dean that may be cut at different periods from their being first set:

Distance of trees from each other, in feet.	Number of years after being set.	Number of trees in an acre.	Number of trees to be thinned.
6	10	1,200	....
10	20	430	770
15	40	190	240
20	60	100	90
25	80	60	40
30	100	45	15

Trimmings, however useful in its place, is sometimes decidedly injurious, and should always be practiced with intelligence. In the oak forest of Sussex it is deemed injurious, as it lets in the air to the heart of the timber. The better way is not to allow large side branches to form by so planting and training that the tree will form one main stem, which is usually the case in woods of proper density.

the King's woods," within the territory now embraced in the State of Maine, set the King's arrow* upon trees that rotted in the forest, or attempted to enforce the severe penalties which their instructions prescribed, it cannot be wondered at that these measures led to mutual recriminations and bitter hostility on the part of the colonists.

In some of the patents for land granted during the colonial period there were, however, conditions relative to the prevention of forest fires which show that the dangers from this cause were then fully appreciated, and some of these provisions embraced in grants made by the colonial government of New York a hundred and fifty years ago would even now be regarded as models in their way, and well worthy of our careful study. These historical features of the timber-question would come properly under the notice of the commission recommended, and would, in many respects, be of great practical value.

EXISTING RESERVATIONS FOR NAVAL CONSTRUCTION.

The attention of our Government was called to the importance of reserving timber for our Navy, and an act was passed March 1, 1817, making reservations of public lands for this purpose. It provided that the Secretary of the Navy, under the direction of the President, should cause such vacant lands as produce live-oak and red cedar to be explored, and selections made as might be sufficient for the supply of timber for the Navy. The President was empowed to reject the whole or any part, and with his approval the lands were to be withheld from future sales. No vested rights were to be impaired. Vessels laden with stolen timber were to be forfeited, and the mode of procedure was specified, and essentially similar to that in case of violations of the revenue laws. Various laws have since been passed, and judicial or official opinions rendered.†

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* Trees are marked by a hammer bearing certain letters indicating that they are to be reserved from cutting, or that they may be cut; and one end of this hammer has a cutting edge for smoothing off the bark. The marking-hammer throughout Europe has been adopted as the symbol of the forester's profession, as the pick has of the miners.—H.

† That this question may be fully understood, we here append an abstract of the official opinions that chiefly control the administration of these reserved lands. Their care was transferred to the General Land-Office in 1855.

REMOVAL OF INTRUDERS ON PUBLIC LANDS.

"Intruding settlers on the public lands may be removed by military force, under act of March 3, 1807. The United States have also all the common-law and chancery remedies enjoyed by individuals under similar circumstances for protection and redress." (Attorney-General's Opinions, I, 471; Wirt, May 27, 1821.)

RIGHTS OF SETTLERS IN EAST FLORIDA IN RESPECT TO CUTTING LIVE-OAK.

"Settlers on the public lands in East Florida, under the act for the armed occupation and settlement of the unsettled part of the peninsula of East Florida, are not entitled to cut live-oak and other timber, except for the purpose of clearing, until they comply with all the conditions of the law.

"The conditions precedent to that right are the obtaining a permit from the register of the land-office describing the place of the intended settlement; the residence in the Territory of five years; the erection of a house fit for the habitation of man; the clearing and inclosing of at least five acres, and actual residence thereon four years next following the first year of the date of such permit; and the proving before the proper tribunal, within one year after the survey of said lands and the opening of the proper office, that the settlement has been commenced on the quarter-section located, and, within six months after the expiration of the five years' residence, the proving of such continued residence and cultivation." (Attorney-General's Opinions, IV, 221; Nelson, Aug. 11, 1843.)

THE UNITED STATES *vs.* EPHRIAM BRIGGS.

"On the 2d of March, 1831, Congress passed an act (4 Statutes at Large, 473) enti-

The amount of public lands reserved by authority of law is now very nearly as follows:

	Acres
In Mississippi	26,218
In Florida	208,824
In Louisiana	9,170
In Alabama	240
Total	244,452

It is proper to remark that the act proposed with this report has no relation whatever to these lands as to their management or use. It is, however, quite probable that great benefits might incidentally accrue,

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tled 'An act to provide for the punishment of offenses committed in cutting, destroying, or removing live-oak or other timber or trees reserved for naval purposes.'

"The act itself declares that every person who shall remove, &c., any live-oak or red cedar trees or other timber from any other lands of the United States shall be punished by fine and imprisonment.

"The title of the act would indicate that timber reserved for naval purposes was meant to be protected by this mode and no other. But the enacting clause is general, and therefore cutting and using of oak and hickory, or any other description of timber-trees, from the public lands is indictable and punishable by fine and imprisonment." (Howard's Supreme Court Reports, IX, 351, January term, 1850.)

RIGHTS OF PRE-EMPTIONERS IN FLORIDA RESPECTING LIVE-OAK, ETC.

"Pre-emptioners under the act for the armed occupation and settlement of the unsettled part of the peninsula of East Florida, approved August 7, 1842, have no right to cut live-oak or other timber for any purpose other than to clear and fence their lands until after five years' occupation shall have enabled them to acquire a perfect title.

"All lands within the prescribed limits as to boundary and quality were open to such settlement, with the single reservation contained in the third section, which prohibits any such settlement within two miles of any permanent military post of the United States, established and garrisoned at the time such settlement and residence was commenced.

"Settlers have all the rights necessary to enable them to perfect their title by clearing, improving, and inclosing the land, but have no right to cut, or to have cut, valuable timber for sale or export.

"Slave property cannot be held for damages." (Attorney-General's Opinions, IV, 405; Nelson, July 16, 1845.)

CIRCULAR OF COMMISSIONER OF GENERAL LAND-OFFICE,

DEPARTMENT OF THE INTERIOR, GENERAL LAND-OFFICE,
Washington, D. C., December 24, 1855.

GENTLEMEN: The Secretary of the Interior has concluded to change the present system of timber-agencies, and to devolve the duties connected therewith upon the officers of the local land-districts. By this direction, therefore, you will, upon the receipt of these instructions, take charge of the timber business within the limits of your land-district, as a part of the general duties of your office; and it is, accordingly, hereby assigned to you as such, with the understanding that, hereafter, it is to be considered and held as a proper incident to, and in fact a part of, your general duties, covered and satisfied by the salary which the law provides for your respective offices.

That you may understand the nature of this part of your duties, your attention is directed to the following:

1st. Attorney-General Wirt, in an opinion of the 27th of May, 1821, holds as follows: "Independent of positive legislative provisions, I apprehend that, in relation to all property, real or personal, which the United States are authorized by the Constitution to hold, they have all the civil remedies, whether for the prevention or redress of injuries, which individuals possess. (See 3 Wheaton, 181.) So the United States, being authorized to accept and to hold these lands for the common good, must have all the legal means of protecting the property thus confided to them that individuals enjoy in like cases. * * * * They are, therefore, in my opinion, entitled to the injunction of waste by way of prevention, and to the action of trespass by way of punishment, in like manner as individuals similarly situated are entitled to them."

2d. Attorney-General Taney, now Chief Justice of the United States, in an opinion of 22d August, 1833, cites this opinion of Mr. Wirt, and concurs in it.

3d. Attorney-General Mason, in a communication of 16th July, 1845, refers to the and suggestions applicable to their management might result from the investigations of the commission of forestry, should this office be created.

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opinion of Attorney-General Nelson, of the 11th August, 1843, and, in concurring in it, states that, "when the right of pre-emption exists, the settler who has complied with the provisions of the act of 4th September, 1841, has a right of occupancy for twelve months, within which he may perfect his title by paying the minimum price of the land. Like the settlers under the armed occupation act, his right is inchoate only; and he has only those rights of property which are necessary to the perfecting of his title. He may clear the land, build on it, and inclose it with a view to cultivation. For these purposes he may use or destroy any trees which may be necessary, but within these restrictions, and necessary fire-wood, he is confined."

The penal act of 2d March, 1831, provides "for the punishment of offenses committed in cutting, destroying, or removing live-oaks and other timber or trees preserved for naval purposes."

This act of 2d March, 1831, you will find fully considered in the case of the United States *vs.* Ephraim Briggs, (9 Howard, p. 351,) in which the Supreme Court decided that the said act authorized the prosecution and punishment of all trespassers on public lands by cutting timber, whether such timber was fit for naval purposes or not.

4th. Under no circumstances will you compound or compromise with any such trespassers, or receive any pay or compensation from them as acquittal or discharge therefrom, or in any other manner; neither will you give any permission to cut timber or otherwise trespass on the public lands, as there is no authority for any such proceeding; but all such offenses against the law must be prosecuted and tried by the authorities duly constituted for that purpose.

5th. Should you find such trespass committed on *swamp* lands, or those which are rendered unfit for cultivation by overflow, you will take no further action than to notify the governor of the State, as all such lands inure to the State under the act of 28th September, 1850.

6th. In the enforcement of the said act of 1831, you should be careful not to interfere with pre-emption rights under the act of 4th September, 1841, the settler, with a view to cultivation, having the right, as hereinbefore indicated, to use or destroy trees in clearing roads and constructing bridges, or for any other purpose connected with the improvement of his homestead.

7th. While thus liberal to the honest settler, you should be vigilant to detect and arrest the speculator, who, in the guise of a settler, and under the sanction of a declaratory statement, may contemplate the spoliation of timber, and unless arrested might seriously injure the public interest.

8th. Where the trespassers are unknown or known, and timber has been cut or removed off the public lands, you will cause it to be seized and sold at auction to the highest bidder, under such regulations as sound discretion may suggest.

9th. All moneys, the proceeds of the sale of timber received by you, must be deposited in some of the United States depositories, to the credit of the judiciary fund, without abatement, and an immediate report made of the same to this Office, with a full statement of all particulars duly verified.

10th. In the prosecution of your duties you may, upon any pressing emergency, deputize a reliable person to investigate and report the facts involved in any supposed case of trespass, and allow a per diem of three dollars and a mileage at the rate of ten cents per mile.

In making any such appointment you will report the fact instanter, and the necessity for it, and will require, in the affidavit of the employé, a statement of the time actually occupied in the service and the distance traveled. An account verified by the party and certified by you should be reported to this Office for payment.

Where there is no pressing emergency for the appointment of an agent, you will refer the facts to this Office for consideration and await instruction.

11th. In returns to this Office of sales of timber you will be careful to designate the places of seizure, the quantity and kind of timber, whether in logs or manufactured, price per foot, with the names and residences of purchasers, and cause the same to be verified by a certificate from the party making the seizure and sale.

12th. You are directed to make a report at the end of each quarter, the first to be rendered on 1st April next, of the proceedings of your office pursuant to those instructions, and showing the operations of this system as preventive means; also the number of acres entered by trespassers through its constraining influence.

You are requested to acknowledge the receipt of this, and advise me of such preliminary steps as you may take with a view to a compliance with the foregoing instructions.

Very respectfully, your obedient servant,

THOMAS A. HENDRICKS,
Commissioner.

With reference to the probable future wants of our Navy, in view of the increasing use of iron in naval construction or the ultimate increase or decrease of demand, we have made no inquiries.

AMOUNT OF TIMBER USED IN SHIP-BUILDING.

With reference, however, to the amount of timber consumed in ship-building, we quote from an English author* the following statistics:

A seventy-four gun ship swallows up 3,000 loads † of oak timber, which is no less than 150,000 cubic feet. It will, of course, take 2,000 large, well-grown timber-trees of two tons each. Now, supposing these trees to have stood at a distance of 33 feet from each other, the distance they should stand at in a plantation for such trees, each statute acre would contain forty trees, and the building of one seventy-four gun ship would clear, of such woodland, the timber of fifty acres. This quantity is certainly very great; and of course an equal proportion will be required, according to their size, from a cutter to a three-decker.

Supposing all the waste lands in Scotland (which, by the report of a committee of the Board of Agriculture, amounts to no less than 14,218,224 acres) to be covered with full-grown oak timber, it would prove very inadequate to replace the British navy and merchantmen as they stood during the last war with France. It must thus be apparent that it is absurd to say there is no use in planting and there never can be a scarcity of timber for ship-building.

We can state from good authority that the annual consumption of timber used for the British navy and merchant-ships alone is not less than 9,963,480 cubic feet; and the quantity used for house-building, machinery, and agricultural purposes will not be less than four times that quantity. Now any one who considers for a moment that nearly the whole of that enormous quantity is imported annually from foreign ports into England, Scotland, and Ireland. Were these foreign supplies cut off, I could aver that before twelve months, to our sad experience as a nation, see a scarcity of timber. From the return of the King's forests it appears that, through mismanagement and inadequate regulations, they do not, on an average, furnish above one-fortieth part of the oak timber required annually for the navy and commercial purposes of Great Britain.

ENGLISH TASTE FOR SYLVICULTURE.

Says an eminent writer:‡

In these islands, where seas have for ages rolled between its inhabitants and invading enemies, the happy security of property, and the taste and opulence of the people, have long given to the culture of trees a place among the favored arts. Not only the noble parks studded with wood, which everywhere abound, but the infinite variety of graceful trees planted in hedge-rows, or standing alone or in groups in the meadows and cultivated fields, give a rich peculiarity to the landscape of England which is to be found in no other country; and when we consider the prodigious value of these masses of timbers, which are suffered by their owners to stand for generations untouched by the hatchet, we see how much of the passion of the English for trees is founded on taste rather than on considerations of gain. This taste, associated as it is with the many feelings of enjoyment which trees afford, doubtless proves a more powerful incentive to planting than any considerations of utility or distant profit; and utility and profit must not, and need not, be disregarded in the forming of the infant forest, or even in establishing the solitary tree; and, happily for the progress of the art, the useful and the ornamental touch at so many points that the cases are rare where they really diverge.

TRIBUTE TO SIR JOHN EVELYN.

There is nothing more pleasing in English history than the record of success shown in efforts of Sir John Evelyn to awaken public interest upon the subject of sylviculture, and to him we may doubtless in a great degree ascribe the marked attention paid in England by the nobility and landed gentry to the cultivation of trees. This elegant writer published the first edition of his work entitled "Sylva, or a Discourse of Forest Trees and the Propagation of Timber" in 1664. It was at once honored by the royal notice, and, like all his other writings, was received with great favor. It was written while employed on a public service scarcely relating to the subject, and, as he says, "from an earnest desire to support the credit of the Royal Society, and to convince the world that philosophy was not barely an amusement, fit only to employ the time of melancholy and speculative people, but a high and useful science, worthy the attention of men of the greatest parts, and capable of contributing in a supreme degree to the welfare of the nation."

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* *Monteath's Foresters' Guide.*—London, 1836, p. 29, quoting Marshall, in part.

† A load or ton of round timber is 40 feet; and of square timber, 50 feet.

‡ Professor Low, of Edinburgh: *On Landed Property and the Economy of Estates*, London, 1856, p. 521.

No tribute more striking or beautiful could be paid by a man of genius to one who had worked so lovingly for the good of his fellow-man than was that by Disraeli, in his Curiosities of Literature, to the memory of the writer under notice. He says:

> Had Evelyn only composed the great work of his "Sylva, or a Discourse of Forest Trees," his name would have excited the gratitude of posterity. The voice of the patriot exults in the dedication to Charles II, prefixed to one of the later editions: "I need not acquaint your Majesty how many millions of timber-trees, besides infinite others, have been propagated and planted throughout your vast dominions at the instigation and by the sole direction of this work, because your Majesty has been pleased to own it publicly for my encouragement."
>
> And surely, while Britain retains her aweful situation among the nations of Europe, the Sylva of Evelyn will endure with her triumphal oaks. It was a retired philosopher who aroused the genius of the nation, and who, casting a prophetic eye toward the age in which we live, contributed to secure our sovereignty of the seas. The present navy of Great Britain has been constructed with the oaks which the genius of Evelyn planted.

FORESTS IN ENGLAND.

The forests* belonging to the crown have been for more than fifty years under the "Commissioners of Woods, Forests, and Land Revenues," who report annually to Parliament, under acts of 10 George IV, (ch. 50,) and 2 William IV, (ch. 1.)

RECENT VIEWS CONCERNING FORESTRY IN ENGLAND.

Within a few years many thousand acres have been planted with oaks by the British government for the future use of the navy. The dependence of manufactures† upon forests, and especially such as use large quantities of wood for fuel or as raw material, is direct and obvious. In a recent article in the Gardeners' Magazine, of London,* the writer, in speaking of the uses of forests, says:

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* Legally, in English law, a forest can only be held in the hands of the sovereign; for this personage alone has power to grant a commission to be justice in eyre of the forest. A chase differs from a forest in being capable of being held by a subject, in being of smaller extent, and subject to the common law and not to the forest law. A chase, also, may be comprised within a forest.

Forest laws are peculiar laws, different from the common law of England. A royal warrant is issued yearly for the supply of venison to the functionaries who are entitled to receive it, and specifies the number of bucks that may be taken for the use of each at the proper season. This number amounts to 611 annually.

†Some idea not only of the large amounts of wood used in manufactures, but also the profits of cultivation, may be formed from a paper published in the Transactions of the Institution of Surveyors, 1872–'73, vol. v, page 189, from which it appears that the consumption of beech-timber for the chair-trade in the neighborhood of High Wycombe and the manufacture of wooden ware and turnery in and around Chesham is estimated at 10,400 loads (of 50 feet) annually at High Wycombe and 2,900 loads at Chesham. The annual cuttings are now sold at the rate of 1*s.* to 1*s.* 6*d.* per cubic foot, and the thinnings have of late realized £1 per acre annually.

> In very few countries do trees multiply faster than men, and as the Anglo-Saxon goes everywhere, with his hatchet in his hand and thoughts of manufacturing in his brain, distant forests that have been described as "interminable" are fast shrinking away, and their end may be foretold without any subtle prophecy. Considered as fuel simply, the forests of the world are of the utmost importance, and it would afford us considerable comfort could we be persuaded that in regions where fuel is most wanted the growth of timber keeps pace with its destruction.
>
> We know it to be otherwise. * * * The great iron-works that were scattered over the weald of Sussex, and of which traces still abound, were kept going with the timber of the district, and the furnaces were only put out because the wealden forests had been consumed.†

The writer we are quoting believes that, as mineral coal becomes dearer from being brought from greater depths, the cultivation of timbers will soon be assumed in England by the government, as upon the Continent, and that the time is near when a school of forestal science under the direction of the state will be established as a testimonial to the national importance of arboriculture.

We are informed that the British government is about taking active measures to ascertain its duties with reference to timber, both in Great Britain and in her colonies.

In the days of Julius Cæsar cultivation was but rudely developed along the southern borders of England, and the greater part was one vast forest. Traces of laws protecting, for the use of the sovereigns, the game of forests may be traced back to the most primitive times.

Sir Henry Spellman, a writer in the days of Queen Elizabeth, enumerates 76 forests.

The present principal English forests are as follows:

New Forest, 65,000 acres, of which 22,319 are under-wood, chiefly oak and beech, with outside clumps of Scotch fir and larch in the older plantations, and oak, Scotch fir, and larch in the younger. Besides the 65,000 acres there are 26,000 the property of private individuals in the forest, with regard to which the Crown rights appear uncertain, if indeed any exist. There is a complete register of commoners and the rights to which they are entitled.

Dean Forest, 22,870 acres, of which 14,754 are in timber, chiefly oak, beech, and fir, with a little chestnut and walnut.

High Meadow, 3,359 acres, all wooded with oak and fir.

Alice Holt, 2,039 acres, all oak, except 100 acres of larch and ash.

Woolmer, 2,808 acres, of which 1,235 are Scotch fir, larch, and pine, with a little oak.

Bere, 1,456 acres of oak.

Parkhurst, 1,160 acres of oak, larch, beech, chestnut, Scotch fir, and stone-pine.

Delamere, 4,022 acres, of which 2,622 are oak, larch, and Scotch fir.

Salcey, 1,277 acres of oak.

Hazleborough, 489 acres of oak.

Epping, 7,000 acres; not owned by the Crown except as to certain forestal rights.

Total of foregoing, 112,376 acres, of which 51,606 are in timber.

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* December 13, 1873.

† The iron palisading inclosing the graveyard of St. Paul's cathedral was the last great work of the Sussex founderies.

THOUGHTS UPON ENGLISH FORESTRY AS COMPARED WITH THE GERMAN METHODS; AND INFERENCES APPLICABLE TO THE UNITED STATES.

The officer of the India forest-service whose language we have repeatedly quoted[*] draws the following comparisons between English and German methods of forest management:

> I do not advance the theory that the German system is perfect, or applicable to all states or circumstances, and still less that we in England do not grow as fine trees, or do not know how to plant and rear young trees for timber. If any have doubts on these points I would point to the Swinley woods, under the charge of Mr. Menzies, and portions of the New Forest, under Mr. Cumberbatch, which may challenge comparison with any oak plantations of the same age on the Continent. But I do think, and am sure, that any who have studied the subject, and made themselves thoroughly acquainted with it by personal observation, will agree with me that, compared with most of the German states, we are (in England) behindhand as regards the systematic and scientific management of forests on a large scale, and as a part of political economy to which it is incumbent on a government to attend. In fact, looking at it in this light, I venture to affirm that we are as far behind Germany in the knowledge and application of scientific forestry as we are in advance with regard to agricultural pursuits.
>
> I grant that for England state-forests are not a necessity, (although I am not sure that we may not some day regret their absence or limited extent,) for she can command the timber, market for [†]—burns comparatively little firewood—has a very small area, almost every acre of which is of great value either for building or agricultural purposes; and from the many large estates which exist throughout the country, and the naturally luxuriant growth consequent on a moist climate, is, on the whole, well wooded, although for the most part the woods are grown for luxury, (*e. g.*, enhancing the beauty of the landscape, affording cover for game,) and not merely regarded as timber-producing areas.
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> Again, private enterprise and intelligence effects a great deal more with us than on the Continent, where governments are still looked to to originate and take the lead; and we often do drift, so to speak, into the right channel without exactly knowing how or why.
>
> I would, therefore, merely venture to remark as to government or state forest-management in England, that where it does exist no efforts should be spared to make it as perfect and as lucrative as possible; and I am convinced that this can only be done by the introduction of a thorough system of rotation and periods based upon carefully-prepared measurements, valuations, and working-plans, forming a definite plan of operations with certain objects in view, and not mere desultory planting, liable to interruption at any time by a change in the government or commissioner of woods, or on the *ex parte* statements of the commoners, whose rights should be settled in one way or another.

FORESTRY IN SCOTLAND.

The growth of forests for timber in Scotland depends chiefly upon the enterprise of individual proprietors; and the details of management of plantations have received careful attention. An estate devoted to the growth of timber, in the hands of a skillful forester, may in some cases show a much greater annual profit than that which would be derived from the rental of the land for agriculture, although the investment may lie for years without the slightest return, and an object of continual expense.* Success depends here, as it will always everywhere, upon the ability of the proprietor to await the results, and a reserve of capital becomes an essential requisite. Still, at every stage the value of each parcel of land may be known, its average rate of growth per acre may be valued, and the prospective value at a given future date, or when finally ready for cutting, may be very nearly ascertained.

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[*] Capt. C. Walker, of Madras. *Reports of Forest Management, &c.*; London, 1873.

[†] What will England do when Norway, Sweden, and North America have no more spare timber to command? Having had for over a century full and unrestrained access to the forests of Canada, and ample opportunities to import from the inexhaustable (?) forests of other countries, it would seem that the thought had never entered the heads of her statesmen and political economists that these opportunities may not last always. Moreover, the humid climate of the British Isles, and their constant exposure to ocean winds charged with moisture, exempts them in a great degree from liability to droughts, so that they would not be as liable to be awakened by them to a realization of the dangers and duties incident to this subject as they would be if they were less favored in this regard.—H.

EXAMINATIONS IN FORESTRY.

To encourage this branch of national industry the Highland and Agricultural Society has established a course of examinations, and under a supplementary charter granted in 1866, for the promotion of agricultural education, it is authorized to grant first and second class certificates in forestry to those who are able to pass these examinations.†

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* In speaking of the woods and plantations of the Earl of Seafield, in Strathspey, Captain Walker says:

"I spent a week in Strathspey, and obtained much valuable information as to the growth of *Coniferæ* from Mr. Grant Thompson, Lord Seafield's wood manager. * * * The tract of country, chiefly moorland, under his charge extends to at least 60,000 acres, of which 30,000 to 40,000, or a little more than half, is now actually under timber. Mr. Thompson's wish is gradually to plant up the whole, so that, in the course of time, 1,000 acres could be felled annually, and a like extent planted out, and I think the object cannot be too steadily kept in view, as it could not fail to bring in a large revenue without impoverishing the forest, or, so to speak, trenching on the capital in timber.

"Mr. Thompson considers that the sale of thinnings, grazings, dues, &c., should suffice not only to pay the establishments employed, (including his own salary,) and the working expenditure for the nursery planting, fencing, &c., but also the rental of the land, which of course is very low, leaving all the proceeds from actual clearing, or what is known as a 'clean cut,' as clear profit." (*Reports on Forest Management*, &c., p. 95.)

The wood-lands of the Duke of Athol extend to upward of 10,000 acres, divided into five districts, each under a separate forester.

The first systematic planting was begun in 1728, by Duke James, who caused extensive plantations of larch and spruce, especially the former, to be formed. Within the last fifty years, however, the Scotch fir has been largely introduced, and grows to great perfection. A disease had attacked the larch some thirty or forty years since, for which there appeared no remedy short of cutting out all the diseased trees and replanting. It was thought to be atmospheric, and made its appearance in a fungous growth on the stem, near the axils of the branches, and then developed itself into or produced a blister, and eventually a hole or wound, as if a branch had been roughly broken off.—(*Ib.*)

† These examinations are open to candidates of any age, nor does it appear of consequence as to where or how the information required to entitle the candidate to certificates was acquired. Their manifest advantage consists in enabling proprietors to engage thoroughly qualified managers to conduct their operations of planting and caring for forests. They also afford a fine opportunity in assisting the ambitious young aspirant for employment in this service, in obtaining situations to which distinguished merit in the examinations would open the door.

A Board of Examiners is appointed upon the following subjects:

I.—*Science of Forestry and practical management of Woods.*

1. Formation and ripening of wood. Predisposing causes of decay.
2. Restoration of wood-lands.
    (*a.*) Natural reproduction.
    (*b.*) Artificial planting.
3. General management of plantations. Cropping by rotation. Trees recommended for different situations.
4. Seasons and methods of pruning, thinning, and felling.
5. Circumstances unfavorable to the growth of trees.
6. Mechanical appliances for conveying and converting timber. Construction of saw-mills.
7. Qualities and uses of chief indigenous timber. Processes of preserving timber.
8. Management of nurseries. Seed-sowing.
9. Collection of forest produce.
10. Manufacture of tar and charcoal.

II.—*Elements of Botany.*

1. Nutritive organs of plants—root, stem, leaves. Functions of roots. Various

SCOTCH PREMIUMS TO ENCOURAGE FORESTRY.

As a further illustration of the encouragement given in Scotland to the subject of forestry it may be noticed that the Highland and Agricultural Society offered, in its premium-lists of 1872, *fourteen* prizes, amounting to one hundred sovereigns, for approved reports on subjects relating to forestry.*

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kinds of stems, with examples. Use of the stem. Structure of leaves. Different kinds of leaves. Arrangement and functions of leaves.

2. Reproductive organs. Flower and its parts. Arrangement of the whorls of the flower. Calyx; corolla; stamens; pistil; ovule; mature pistil, or fruit. Pruning and grafting. Seed. Young plant, or embryo. Sprouting of the seeds or germination.
3. General principles of classification. Meaning of the terms "class," "order," "genus," "species." Illustrations taken from common forest-trees and shrubs.

Practical examination of fresh specimens and models. Some of the latter may be seen in the museum of the Royal Botanical Garden, which is open daily to the public, free.

III.—*Nature and properties of Soils. Drainage. Effects of Climate.*

1. The different descriptions of soils, their classification and suitability to growth of different descriptions of timber-trees.
2. The composition and constituents of soil. The relations between the soil and the trees growing on it.
3. The effects of drainage on soils and on climate.
4. The mode of drainage for plantations.
5. The influence of temperature, rain-fall, aspect, shelter, and prevailing winds on tree-life.
6. The methods of registering and recording observations, and the instruments used.

IV.—*Land and Timber measuring and surveying; Mechanics and Construction, as applied to Fencing, Bridging, and Road-making; Implements of Forestry.*

1. The use of the level and measuring-chain. Measuring and mapping surface areas.
2. The measurement of solid bodies, as timber, stacked bark, fagots, &c.; earthworks.
3. The different modes of fencing and inclosing plantations; their relative advantages, durability, cost of construction and repairs.
4. The setting out and formation of roads for temporary and permanent use.
5. The construction of bridges over streams and gullies; of gates or other entrances.
6. The different implements used in planting, pruning, felling, barking, and working up timber-trees, or preparing them for sale.

V.—*Book-keeping and Accounts.*

1. Questions in practice and proportion.
2. Book-keeping. Describe books to be kept. Give examples. Taking of stock.

The syllabus mentions, under the second subdivision of Professor Balfour's "Elements of Botany," and under the fourth "Ewart's Agricultural Assistant," and Strachan's "Agricultural Tables," as furnishing information valuable in these branches of the examination.

Some of the most distinguished professors of the universities, and men of the greatest eminence in agricultural science, are selected as examiners in forestry, and several of the young men who have passed the examinations had acquired their knowledge in the forest-schools of France and Germany.

* These were as follows:

1. By a proprietor who shall, within the five preceding years, have planted not less than one hundred and fifty acres.—The gold medal.

2. By a practical forester, on the management of plantations, from the commencement of the first thinning till the period of yielding full-grown timber.—The gold medal or ten sovereigns.

3. On successful planting within the influence of the sea, or on exposed sterile tracts, founded on observation of the habits and appearance of the different sorts of trees considered best suited for such situations.—The gold medal or ten sovereigns.

4. On plantations of not less than eight years' standing formed on deep peat-bog.—The medium gold medal or five sovereigns.

5. On the more extended introduction of hardy, useful, or ornamental trees which

FOREST-CULTURE IN INDIA.

The necessity of preserving tropical forests has fortunately attracted the notice of government in British India, where the importance of maintaining an equilibrium of temperature and humidity is of more immediate consequence to the social welfare; and the growing demands for railroad use, and the various applications of the arts, render it a subject of direct practical utility.

A committee of the British Association for the Advancement of Science was appointed, in 1850, to consider the probable effects, and their report made at the Ipswich meeting in 1851.* Forest establishments were sanctioned in British Burmah in 1855, and in the Madras presidency in 1856. In 1864, government laid the foundation of an improved general system of forest administration, for the whole Indian empire, having for its object the conservation of state forests, and the development of this source of national wealth. The experience acquired in the forest-schools of France and Germany has been brought to apply in this great national undertaking. Among the more important general principles laid down for the execution of this measure is, that all superior government-forests are reserved and made inalienable, and their boundaries marked out to distinguish them from waste lands available for the public. The act of 1864, defining the nature of forest rules and penalties, has been adopted by most of the local governments, and the executive arrangements are left to the local administrations. Various surveys have been made to obtain accurate data concerning the geographical and botanical characteristics of the reserved tracts, and the kinds of timber best adapted for various localities has been carefully ascertained.

In 1866, the government resolved upon sending out five young men, duly qualified by education in the forest-schools of France and Germany, for the forest department of India. An arrangement was made the same year, by which forest-officers in the India service, who might come to Europe on furlough, would be able to increase their professional knowledge by studying forest management and other subjects connected

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have not hitherto been generally cultivated in Scotland.—The medium gold medal or five sovereigns.

6. On the value, for economical purposes, of the Corsican fir and its adaptation to different soils and situations.—The medium gold medal or five sovereigns.

7. On the *Abies Douglasii.*—The medium gold medal or five sovereigns.

8. On the stem and branch pruning of Conifers.—The medium gold medal or five sovereigns.

9. On the treatment and management of oak coppice in Scotland.—The medium gold medal or five sovereigns.

10. On the more extended cultivation in Scotland of charcoal-producing plants for gun-powder or commercial purposes.—The medium gold medal or five sovereigns.

11. On the woods, forests, and forestry in the county of Perth.—The gold medal or ten sovereigns.

12. On the woods, forests, and forestry in the county of Aberdeen.—The gold medal or ten sovereigns.

13. On the systems of management pursued in the state forests and the forest-schools of Germany.—The gold medal or ten sovereigns.

14. On sawing-machinery (water or steam) employed in converting timber in the highlands of Scotland, with descriptive details and specifications.—The medium gold medal or five sovereigns.

* Report of the committee appointed by the British Association to consider the probable effects in an economical and physical point of view of the destruction of tropical forests, by Dr. Hugh Cleghorn, Madras medical establishment; Prof. Forbes Boyle, King's College, London; Capt. R. Baird Smith, Bengal, engineer; Capt. R. Strathey, Bengal, engineer. (*Rep. Brit. Asso.*, 1851, 1, 78.)

An article on the distribution of the principal timber-trees of India, and the progress of forest conservancy, by Dr. Hugh Cleghorn, (*Brit. Asso.*, 1868, p. 90,) affords many additional details upon this subject.

with forestry in Great Britain and on the continent. A number of officers have availed themselves of these arrangements, and it appeared desirable to publish a selection of such reports received as seemed likely to prove useful to others who might follow their example. A collection of these, prepared by Captain Walker, of the Madras forest-service, has very recently been published.*

At the moment of our writing, the public journals are giving most painful accounts of the distress in India from famine, and the British government is putting forth its utmost efforts to alleviate the miseries which it will be impossible to prevent, and which, from present appearances, must result in the starvation of thousands of the native population who live remote from bases of governmental supply. From a careful study of this subject, with such data as are accessible in late reports, we cannot doubt but that this calamity is largely due to the fact that the forests have, within recent years, been swept off by demands for railroad and other uses much more rapidly than formerly, and that the exposure to winds and sun, thus occasioned, may have largely contributed to these painful results. The remedies are to be sought by a removal of the cause, and in the restoration of that due proportion of forest-shade upon which agriculture depends for success. If the officers to whom the opportunities for European observations fall improve them as well as some whose labors are reported in the book edited by Captain Walker, we may reasonably hope for a radical but not an immediate restoration of abundant harvests and general prosperity throughout these vast countries.†

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* Reports on forest management in Germany, Austria, and Great Britain, by Capt Campbell Walker, F. R. G. S. staff corps, Deputy Conservator of Forests, Madras; with extracts from reports by Mr. Gustave Mann, Mr. Ross, and Mr. T. W. Weller; and a memorandum by D. Brandis, Ph. D., Inspector-General of Forests to the Government of India, on the professional studies of forest-officers on leave. London, 1873.

† Mr. D. Brandis, Inspector-General of Forests to the government of India, in a paper on the professional studies of forest-officers on furlough in Europe, makes some very pointed remarks in reference to the results of these opportunities, which have, in analogous cases, a wide range of application. After naming several who had availed themselves of the privilege, he says: "With great perseverance and industry these officers went through a regular course of studies in the mixed beech and oak forests of Villiers Cotterets, in France, at Nancy, and in the spruce and silver fir forests of the western Vosges near Remiremont. They derived great benefit from what they learned, and their example has been followed by a number of forest-officers from different provinces of India. Some of these have, I believe, profited much, and the reports which preceded these remarks afford ample proof of the great importance of these studies, when undertaken in the right spirit and in a proper methodical manner. Others may have returned to India dissatisfied with the result of their professional studies at home; if so, the reason probably was that they went to work in a *dilettanti* sort of fashion, and that, instead of going through the labor of mastering the details of forestry, they imagined that their experience in India entitled them at once to come to conclusions of a general and sweeping nature after a hurried journey through the country. On this account, I am anxious at the outset to state my opinion in unmistakable terms, that those only should avail themselves of these facilities now offered for their professional studies who are able and willing to devote sufficient time to them." (*Reports on Forest Management*, &c., p. 167.)

Again, in speaking of the idea of deriving benefits applicable in India from the experiences of Europe, where the climate, species, and conditions are so entirely different, the same writer remarks:

"There is hardly a question of difficulty or importance which arises in connection with forest administration in India, whether in regard to forest rights, or the working on the regeneration and improvement of the forests, which have not been dealt with practically over and over again by foresters in Europe. It is not too much to say that no important steps should be taken in Indian forest-administration, without first ascertaining what has been done, or what ought to have been done, under analogous circumstances in Europe. And whatever progress has been made in Indian forest-man-

FORESTRY IN FRANCE; HISTORY.

The importance of forests in relation to agriculture, industry, and the public defense, has been recognized in this country for centuries, and has given rise to much special legislation and governmental regulation. In the earliest period of history, the abundance of woodland appears to have sanctioned unlimited destruction, and two statutes, (*capitulaires*,) of Charlemagne and of Louis the Fair, ordered the clearing off of all lands susceptible of cultivation, and forbade the formation of new forests without the royal permission.

In 1280, Philip III prescribed rules for the administration of forests, and we occasionally find allusion to the subject in the acts and decrees of the government, but without any marked event, for some centuries, to indicate an advance of intelligence with reference to the true policy that should be pursued in reference to forests. Their management did not depend upon any principles of science, but rather upon chance, until, in 1669, when an ordinance was issued by Louis XIV, at the instance of Colbert, the celebrated statesman of that period, which gave the first intelligent direction to forestry as a science.

This ordinance, called into existence by the growing want of firewood, and of timber for the marine, and by the injuries that were observed to happen to the agricultural interests of the country by exposing the soil too much to the drying effects of the sun and the winds, may justly be regarded as affording the best claim of this eminent practical economist to the grateful remembrance of posterity.*

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agement, that progress is due to a great extent to the lessons we have learnt in the public and private forests of Europe." (*Ib.*, p. x.)

Captain Walker, in speaking of the wants of India in regard to forests, says:

"Not only is there a large, and even increasing local demand to meet the wants of a population of upwards of 200,000,000 in the shape of building-materials and fire-wood, a demand which can never be met from abroad, but we have to consider such questions as climate, rain-fall affecting the irrigation and cultivation of thousands of acres, and supply of wood-fuel to the railways, any curtailment or enhancement of price in which means greatly increased working expenses, and consequent loss to government.

"In India the people still look to government for everything, and will do so for many a year to come, and there is little or none of that private enterprise which will plant and conserve forests on scientific principles, introduce better methods of felling and converting timber, and look into and provide for the future and its wants.

"All this devolves on the government, and particularly so, I consider, with regard to forests, which must be regarded and managed as a whole, and with regard to the general good, and cannot be left to the individual caprice of private individuals or even communities; for trees do not grow in a few months or a year, like rice or corn; nor can one portion of a forest be managed like a field, without reference to the surrounding tract."

* This ordinance was meditated and prepared during eight years by Colbert, and by the most skillful men that he was able to assemble from all parts of the kingdom. It was for the most part in operation until the promulgation of the new forest-code, and has given rise to several commentaries, of which the following are the principal:

Conférence des nouvelles ordonnances de Louis XIV, pour la reformation de la justice, (de 1667, 1669, 1670, and 1673.)

Philippe Bornier. Several editions of this have been published, the last of which appeared in 2 vols., 4to., in 1760.

Nouveau commentaires sur les ordonnances d'août 1669, *et mars* 1673; par Jousse, Paris, 1761, 1 vol., 12mo.

Commentaire sur l'ordonnance des eux et forêts, du mois d'août 1669, Paris, 1772, 1 vol., 12mo.

The ordinance was divided into 32 titles and extended to nearly 100 octavo pages.[1] The recital in its preamble we deem highly instructive, as presenting the view then had of the importance of this subject; while the results to which it led are full of encouragement, because they show that these efforts brought the relief intended, and saved France from the dangers then threatened. It was as follows:

"LOUIS, &C.—Whereas the disorders which have found their way into the manage-

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[1] Report of M. Roy to the Chamber of Peers, upon the Code-forestière.

The terms of this ordinance excited much opposition, but the firmness of Colbert secured it so firmly that it remained in force until 1790, when a law was passed abolishing special jurisdictions, organizing the forest administration, defining its duties, and regulating the care of communal and public woodlands, but continuing the ordinance of 1669, except as otherwise superseded by later laws.

FRENCH FOREST-CODE.

A project, prepared by a special commission appointed in 1823, was submitted to the government in 1826, and constitutes the present Forest-code of France. It was sanctioned May 21, 1827, and promulgated on the 31st of July following.

Although this code is very severe, it has not prevented the destruction of valuable forests in the south of France, among the Pyrenees and the Alps, and much of the old forests of Brittany.

This administration in France is intrusted to the Ministry of finance, and the head of the department is the Director-general. He is assisted by two Administrators, one charged with the management of the forests and the sale of the products, and the other with the police of the forests and the forest-laws. In the departments there are thirty-two Conservators, each in charge of one or more departments, according to the extent of forest in each. The immediate supervision is intrusted to inspectors, who are assisted by sub-inspectors and gardes-généraux, who live near, and personally superintend all operations and work of the forest-guards. The "brigadiers" and forest-guards live in houses in the forests and serve as a police over a certain range. They are required to be present at all operations and to go around their ranges at least once a day to report any violation of forest-laws that may take place.

The saw-mills in the forest are usually owned by the government and hired at a certain rent to the wood-merchants, who buy the cuttings. No timber is allowed to be sawn up before it is inspected and marked by the forest-guard, under the superintendence of the inspector or his sub-inspectors. The mark is made with the head of a hatchet having the letters "A. F.," (*Administration Forestière.*)

In designating trees to be cut or reserved, entries are made in a note-book. The most favorable season for felling timber is at the end of autumn and in winter, especially the hard-wood trees. The branches are mostly lopped before felling, to lessen the harm they might do to other trees, and to prevent the timber itself from breaking. Good roads are essential to a forest.

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ment of the waters and forests of our kingdom have become so general and so inveterate that remedy appears almost impossible; nevertheless, Heaven has so favored the application of the eight years which we have devoted to the re-establishment of this noble and precious part of our domain, that we now see it in condition to flourish more than ever, and to yield in abundance to the public all the advantages which it is possible to hope as well for the conveniences of private life as for the necessities of war, or, lastly, for the ornaments of peace, and the increase of commerce by long voyages to all parts of the world. But as it will be of little service to establish order and discipline, if we cannot make sure, through good and wise regulations, to transmit their fruits to posterity, we have therefore deemed it an act of justice to consummate a work of such utility and necessity, by causing to be digested all the ordinances, both ancient and modern, that relate to this subject, to the end that the conferences had, under the advice which we have gathered from the provinces by means of the commissaries deputed for the reformation of waters and forests, may be formed into a body of clear, precise, and certain laws, which shall dispel all the obscurity of precedents, and leave nothing as a pretext or excuse for those who may fall into error. To this end, after hearing the report of the intelligent and skillful persons versed in these matters, it pleases us to decree as follows."

PRINCIPLES ADOPTED IN MANAGING FRENCH FORESTS.

The leading principles which prevail in the forest-culture of France may best be stated in the language of a recent prize-essay published by the Highland and Agricultural Society of Scotland:*

EXTENT OF FRENCH FORESTS.

The extent of the state forests in France, with those lately added which belonged to the Crown property, such as Compiègne, Fontainebleau, and Rambouillet, is about 3,130,000 acres. To these may be added 5,335,000 acres belonging to the communes, corporations, hospitals, and other public establishments; so that the whole extent of forests under the management of the forest administration is about 8,465,000 acres.†

These forests are very unequally distributed over the country; a very large proportion of them is spread over the departments of the east, especially the Ardennes, Meuse, Meuth-et-Moselle, Vosges, Duobs, Jura, Haute-Saône and Côte d'Or; and there are many large forests around Paris, and on the banks of the Loire, notably the forests of Blois and Orleans. The south and southwest possess a good deal of forest, as also do the departments of Picardy; while in Brittany and in most of the west coast there is but little forest; hardly any belonging to the communes.

The "*Landes*" of Gascony and the mountains of Savoy and Nice are in process of replanting, and will, it is hoped, soon give a large quantity of fine timber. The whole extent is divided into thirty-two conservations, and the colony of Algeria is divided into three forest provinces—Algiers, Bona, and Constantia.

KINDS OF TIMBER GROWN IN FRANCE.

The chief trees which form, by themselves alone, large extents of forest in France, are the oaks, (*Quercus robur*, *Q. pedunculata*, and *Q. suber*,) the beech, the silver-fir, the spruce-fir, the pines, (*Pinus sylvester*, *P. pinaster*, *P. halepensis*, &c.,) and the larch. The latter tree is only found, and then only in small forests, in the Savoy Alps, and in primitive forests of the Vosges and Jura Mountains.

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*By J. Sykes Gamble, B. A., Oxford, *Tr. Highland and Agricultural Society of Scotland*, fourth series, vol. iv., p. 240, 1872.

† *Annuaire des Eaux et Forêts*, 1870. Nearly 1,000,000 acres have since gone with Alsace and Lorraine, under German rule.

The most important forests in France are as follows:

		Hectares.[1]
In the north:		
The forest of	Fontainebleau	17,300
	Compiègne	14,000
	Rainbouillet	13,000
	Villers Cotterets	11,500
	Mormal	9,000
In the east:		
The forest of	Chaux	11,500
	La Harth	14,500
	Hagueneau	15,000
	Dabo	11,000
	Haye	7,000
	Grande Chartreuse	10,500
In the west:		
The forest of	Lyons	10,500
	Bercé Perceigne	10,500
	Ecoures	7,500
In the central part:		
The forest of	Troncais	10,500
	Orleans	37,600
	Viezron	5,200
	Chateauroux	5,100
	Bertranges Guerigny	5,300
In the south:		
The forest of	La Maitrise de Quillan	11,500
	Soule	7,000
	Lannet	5,000

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[1] The hectare equals 2 acres, 1 rood, and 35 perches.

The oak, the chief timber-tree of France, is of two principal species, viz, *Quercus robur* and *Q. pedunculata*, (Duhamel,) which resemble each other very much. Wherever it is found possible to grow the oak well it is cultivated, generally along with either the beech or the horn-beam. The *Quercus robur* is generally found with the beech on hill-slopes, while the *Q. pedunculata* and the horn-beam prefer the fertile and deep soils of the plains.

POLICY OF FRENCH FORESTRY.

As the wants of France in oak timber are very great, owing to the enormous quantity used in cooperage and for parquet-floors, as well as for ship-building, the internal production is very much less than the wants of the country; and the great aim of French forestry is to provide, wherever their forests will grow it, a large supply of oak timber for the future, when the forests of other nations. such as Hungary, shall become exhausted. It is stated[*] that Austria is now cutting down all her fine forests of oak in Croatia and Slavonia. The wood is bought up very cheap and exported from Trieste, chiefly to form staves for cooperage in France and England. In North Germany, where the forests are very extensive, there is also great want of oak timber of large dimensions, owing to the custom of rarely letting the trees grow after one hundred years.[†] Consequently, not only does the Government of France strive to favor in every way the growth of oak timber, but it postpones felling the trees until their maturity, at an age of from one hundred and fifty to one hundred and eighty years. In the south of France, especially in the departments of Lot-et-Garonne, Pyrénées-Orientales, and Var, and in Corsica and Algeria, the greater part of the cork which we employ is produced. This comes from the cork-oak (*Quercus suber*, L.) principally; but the cork given by the western oak, (*Q. occidentalis*, Gay,) growing along the Gulf of Gascony, between Bayonne and Bordeaux, is also much esteemed. The beech is found over the

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The subdivision of woodlands in France is stated, upon authority of reports made in connection with the Paris Exposition, to be as follows:

Of 1,100,000 hectares belonging to the state, 49 per cent., equal to 539,000 hectares, are in timber, and 51 per cent., equal to 561,000 hectares, in coppice, with or without timber.

Of 2,200,000 hectares owned by communes or public establishments, 36 per cent., equal to 720,000 hectares, are covered with timber, and 64 per cent., equal to 1,280,000 hectares, with timber or coppice alone.

Of 3,800,000 hectares owned by private owners, 17 per cent., equal to 980,000 hectares, is in timber, and 83 per cent., equal to 4,814,000 hectares, in coppice, with or without timber.

ANNUAL PRODUCE.

The annual products of these forests are in the proportions of 3 for the state lands, 2.75 for those of the communes, and 2 for those of the part belonging to private owners. Total yield, 20,000,000 cubic meters, of which 2,000,000 are for timber and the arts, and 18,000,000 for fuel.

Although these resources are on the increase, in consequence of improved methods and increase of facilities for transportation during the last ten years, the production is still far from sufficient to supply the demands for consumption. This annual demand in France for constructive purposes and mechanical use, is as follows:

	Cubic meters.
Naval and mercantile marine	118,000
Artillery and engineering	30,000
Railways	600,000
Building	1,600,000
Laths, wood, and espaliers, &c	3,700,000
River navigation, carriage-building, furniture, utensils, &c	4,800,000
Total	10,348,000

For fire-wood the demand is 30,000,000 steres,[1] and for charcoal, 15,000,000 steres.

The consumption exceeds the production by 8,000,000 cubic meters for timber and construction, and 15,000,000 for fire-wood—the balance being drawn from Norway, Russia, Germany, and Italy.

The importation of common woods of all kinds in 1855 was less in value than 70,000,000 francs, and in 1865 it was 154,000,000 francs. (*Condensed from reports of United States commissioners to the Paris Universal Exposition*, 1867, i, p. 152.)

[*] *Revue des Deux Mondes*, April 15, 1871. "*Les Chênes de l'avenir*," C. Broillard.

[†] *Id.*, September 15, 1871.

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[1] A stere equals 35.3174 cubic feet; 1 cord equals 362 steres, nearly.

temperate and colder regions of France, and especially in the mountains of the Vosges, and on the limestone-hills of Lorraine it takes a fine growth. It is generally found mixed either with the oak or silver-fir, with which tree it agrees very well in mixture, as the silver-fir overtops the beech and shelters it, while the beech prevents many branches forming on the trunk of the fir. The beech also has tracing-roots near the surface and draws its nourishment from a less depth than the silver-fir with its penetrating roots. These advantages are the same as gained by the mixture of oak with beech or oak with horn-beam. Beech is employed chiefly for furniture, sabots, &c., and it has lately replaced oak in the furnishing of railway-sleepers. For this purpose, when creosoted or impregnated with the sulphate of copper, it is found to answer well. The ash, elm, maples, birch, aspen, poplar, &c., are found disseminated in most of the forests of the temperate region and serve for the same purpose as in England. The chestnut is rarely found wild in the forests, but is made the object of a special culture in coppice to provide vine-stakes and hoops for wine-casks. In Auvergne it is much cultivated, also, for its fruit, and its culture is one of the chief sources of revenue in that country. The silver-fir forms magnificent forests in the Vosges and Jura, growing to a height of nearly 150 feet. Two average trees cut down in presence of forest-students in 1871, in the forest of the Hohwald Vosges, measured respectively 40 and 42 meters in height, (132 and 138 feet,) with 8 and 11 feet in girth. The spruce fir also grows to a great height in the forests of the Jura. A trial-place made in the forest of Gilley, near Pontarlier, Jura, gave per quarter-hectare (⅝ acre) seventeen trees, varying in height from 100 to 120 feet, and from four to eight feet in girth, and yielded 1,600 cubic feet per acre.

These two trees give a large proportion of the planks and other description of fir-timber used in France, the produce of the Vosges being chiefly directed toward Paris, and that of the Jura toward the valley of the Rhine and Marseilles. The late war has unfortunately deprived France of many of her finest forests, and indeed of all her forests of Scotch fir, the chief forests of that species having been those of Haguenau, in Alsace, and Bitche, in Lorraine. The maritime pine (*Pinus pinaster*, Sol.) is grown in large forests in the west of France, and for two special purposes; first, for its turpentine, which is extracted by means of an operation called "*gemmage*," which improves the quality, though it slightly diminishes the quantity of the timber produced; and second, as a forest of protection, in covering the sand-dunes of the coast of Gascony, where the fine sand and the salt are very favorable to its growth. The Aleppo pine (*Pinus halpensis*, Miller) forms large forests in the south of France. It also gives a certain amount of resin, but the forests are very liable to fires during the hot, dry summers of that region. Several other pines are also found, such as the *laricio*, which grows abundantly in the mountains of Corsica, and gives good masts for the dock-yards of Toulon; the *Pinus uncinata*, *P. cembra*, and many introduced species.

Attempts at acclimatization, or even at naturalization, are rarely made by the government, but private persons have succeeded in making good profit out of such trees as the Austrian and Weymouth pines, the plane, and the locust tree, (*Robina pseudacacia*, L.,) and out of the larch and Scotch fir, at other points than their natural stations.

FRENCH FOREST-REVENUES.

The annual rental of hunting privileges in the forest domain of France was stated some ten years since to be about 300,000 francs; that of the cutting of wood at nearly 30,000,000 net.*

RECENT PROPOSALS CONCERNING FRENCH FORESTS.

Proposals have been repeatedly made, and with particular force in December, 1872, to the National Assembly for the transfer of the forest administration of France from the Ministry of Finance to the Ministry of Agriculture and Commerce, upon the ground that the object should rather be to serve the future welfare of the country in the maintenance and increase of timber and wood-supply, and to protect the mountains against denudation, rather than to manage them simply as a financial operation for greatest profit. The report on this subject by a special commission, published in the *Journal Officiel de la Republique Francais* of December 30, 1872, and January 9, 1873, contains much interesting statistical information and a summary of the financial results of several extensive

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*Clavés, *Études sur l'Economie forestière*, 1862, p. 302.

sales of state forest-property since 1860. The report gives in round numbers the area of state forests at 900,000 hectares; communal forests, 2,000,000 hectares; and private forests, 6,000,000 hectares; total, 8,900,000 hectares.

PRINCIPLES OF LAW UPON WHICH THE FOREST-CODE OF FRANCE IS FOUNDED.

These principles have been stated with great precision by Professor Macarel in his "*Cours de Droit Administratif.*"[*] As they embrace views applicable in other countries under like necessities, being, in fact, an extension of the right of Eminent Domain, or that maxim of Roman law, "*salus populi suprema lex est.*" It is inherent in the fundamental organization of all governments, and essential to their very existence, and in this connection applies to the highest interests of the state, in the maintenance of itself, through the existence of a sufficient timber-supply. As the writer, we have noticed, deals with these principles, we deem it proper to here present his argument in as literal a translation as possible:

RESTRICTIONS IMPLIED IN THE FREE ENJOYMENT OF THE SOIL.

§ 1. *As to the woods and forests.*

I. The preservation of forests is one of the first interests of society, and consequently one of the first duties of government. All the wants of life are closely related to their preservation; agriculture, architecture, and almost all the industries seek therein their aliment and resources, which nothing could replace.

Necessary as are the forests to the individual, they are not less so to the state. It is from thence that commerce finds the means of transportation and exchange, and that governments claim the elements of their protection, their safety, and even their glory.

It is not alone from the wealth which they offer by their working under wise regulation that we may judge of their utility. Their existence is of itself of incalculable benefit to the countries that possess them, as well in the protection and feeding of the springs and rivers as in their prevention against the washing away of the soil upon mountains, and in the beneficial and healthful influence which they exert upon the atmosphere.[†]

Large forests deaden and break the force of heavy winds that beat out the seeds and injure the growth of plants; they form reservoirs of moisture; they shelter the soil of the fields, and upon hill-sides, where the rain-waters, checked in their descent by the thousand obstacles they present by their roots and the trunks of trees, have time to filter into the soil and only find their way by slow degrees to the rivers. They regulate, in a certain degree, the flow of the waters and the hygrometrical condition of the atmosphere, and their destruction accordingly increases the duration of droughts and give rise to the injuries of inundations, which denude the face of the mountains.[‡]

The destruction of forests has often become to the country where this has happened a real calamity and a speedy cause of approaching decline and ruin. Their injury and reduction below the degree of present or future wants is among the misfortunes which we should provide against, and one of those errors which nothing can excuse and which nothing but centuries of perseverance and privation can repair.

Penetrated with these truths, legislators have in all ages made the preservation of forests an object of special solicitude.

Unfortunately, private interests, that is to say, the action of those who do not directly feel the power of the government, are often opposed to this great national interest, and the laws framed for protection are often powerless.

During many ages the efforts of kings have been struggling continually against the abuses to which the state forests are exposed, and against the improvident speculations of private owners, but these efforts have not always been crowned with success.

These growing disorders, and the necessity of finding an effectual remedy, arrested the attention of Louis XIV, and the ordinance of 1669, which was the fruit of a long investigation and much skillful counsel, may be ranked among the beautiful monuments of a reign illustrious in every kind of glory.

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[*] Vol. III, p. 50. Although this author has been dead some twenty years his works are still held in the highest esteem, and are scarcely surpassed by those of later date.

[†] *Exposé des motifs du code forestiér, a la chambre des Deputés*, December 29, 1826.

[‡] Cazeaux, *Des agents de la production agricale.*

Notwithstanding the severity of these ancient regulations, the forests in France have not ceased to loose their extent, because the increase of population tends constantly to reduce their limits to a narrower space. To this cause, which is always in operation, may be added, since 1791, others of equal or greater power.

The ordinances prior to the revolution carried too far the restrictions imposed on private owners. The new regulations fell into the opposite extreme and allowed the proprietors free and absolute liberty to dispose of their woods.

A large destruction followed this imprudent transition from excess of restraint to excess of liberty.

The proprietors abused this unwonted freedom, and clearings multiplied infinitely, without distinction as to the places where they were made, so that in many localities the washing down of the denuded soil, and the deforesting of mountains, caused the soil needed for vegetation to disappear, and left the rocks naked.

The rise in the price of wood and the easy and certain resource offered to proprietors in the clearing of a planted tract, when compared with the remote and eventual advantages offered in their preservation; the hope of compensation, and beyond this the advantages in one way and another of cultivation, may be recognized as among the causes which sufficiently explain the inducements offered to many of these proprietors, which led them to undertake these clearings.

At length, this progressive deforesting of the soil of France, joined with the incessant need of fire-wood, and the demand for wood by a great number of manufactories, and constructions of various kinds for the public service, such as ship-building, and buildings for various uses, which must be constructed and maintained, had, during forty years, made sad havoc with our reservations of forest wealth.

II. A renewal of the ancient prohibitions by the law of 9 Floreal, year XI, was deemed necessary to oppose this excessive clearing of woods by private owners. It was accordingly decreed that, during the twenty-five years, counting from the date of promulgation, no wood should be cut or carried off unless six months' previous notice had been given by the proprietor to the forest-conservator of the arrondissement in which the wood was located. (Art. 1.)

Within this time the forest administration might object to the clearing off of the wood, and was charged to refer the question before the end of this time, to the minister of finances, upon whose report the government might definitely decide within the same time. (*Ib.*, Art. 2.)

It, therefore, resulted in this, that to make a clearing an *authorization precedent of the administration* was necessary, and that if the administration thought proper not to grant this, the proprietor was restrained by the prohibition against cutting.

III. The Forest-code of May 21, 1827, made some changes in these arrangements.

It began by stating the general principle that "individuals may exercise over their woods all the rights resulting from ownership, saving the *restrictions* imposed by the present law." (Art 2.)

The following were these restrictions that were made applicable to these clearings:

Until July 31, 1847, no individual could cut down or clear off his woods until after having previously made a *declaration* to the sub-prefect at least six months in advance. Within these six months the forest administration might signify to the owner its *opposition* to the clearing.

Within the six months dating from this signification, this might be substantiated by the opposition of the prefect, saving the right of reference to the ministry of finance.

If within these six months, after notice of opposition, the decision of the minister was not rendered and notified to the owner of the woods, the clearing might be made. (Forest Code, Art. 219.)

IV. This restriction does not apply:

1. To young woods during the first twenty years after their seeding or planting.
2. To parks or inclosed gardens attached to dwellings.
3. To woods not inclosed, less than four square hectares (9.88 acres) in extent, when they do not form part of other woods that have an area of four hectares, or that are not located on the tops or slopes of mountains. (*Ib.*, 223.)

With regard to all these the owners were entirely forbidden the right of enjoyment.

V. Thus, accordingly, as to this branch of agricultural industry, the general law of our country is, that the owners are free to vary, within certain limits, the cultivation and working of their lands.

But, as to woods and forests, the public interests demand that individuals shall not be free to clear them from the soil whenever they please.

Not only is it prohibited from clearing, as above mentioned, without first obtaining authorization, but the forest administration may prevent them if they attempt it.

From hence it follows: 1st. That the administration has the right to pronounce its prohibition against clearing whenever it is deemed that the public interests require that this shall be done; and 2d. That it is the duty of individuals, in the first place, to comply with the formalities established by the law, to the end that the government may avert the intention which may be had as to the clearing of the woods, and that it shall subject the offender, in case of violation of this regulation, to the penalties declared by law. These penalties consist partly in a fine of not less than 500 nor more than 1,500 francs for every hectare of wood cleared; and besides this the obligation of re-establishing these places as woodland within a time to be fixed by the tribunals, but not to exceed three years. (Art. 220.)

The legislator has nevertheless not wished that proprietors should remain long under the menace of these penalties, and has reduced the limit to two years, dating from the time when the clearing was finished, this public action having for its object the clearings made in contravention of the prohibitions. which I shall come to notice. (Art. 222.) To the forest administration and the public ministry the vigilance of these public interests is confided. Some of these regulations, it is true, are only temporary, but the necessities of France are such that they will probably be renewed when the time fixed for their limit shall have expired. There can be no doubt that within a year a discussion will be raised in the legislative chambers upon this important point in our social economy.*

VI. The regulations I have been noticing relate to the woods owned by individuals. The law has also provided for the cases of woods owned by communes and public establishments. These are not transitory, but are permanent and continual. The 91st article of the Forest Code is in effect thus stated:

"The communes and public establishments shall make no clearing of their woods without an express and explicit permission of the government; and all who may order or execute such work without this authority, shall be liable to all the penalties contained in title XV against individuals for contraventions of the kind."

VII. Another restriction of an equally temporary nature has been established by the Forest Code. Its duration was much shorter, and although its limitation has expired, it may be proper to remark concerning it:

It was introduced, or rather renewed, in the interest of the service of naval construction. These structures require the use of a great number of choice trees of very considerable size. It is one of those uses that affect the highest interests of the country, and which is the duty of legislation to insure by every means within the power of law. The 124th article of the Forest Code provides that "during the ten years following the promulgation of the Forest Code, the department of the marine shall enjoy the right of making choice, and of marking, in the woodlands of individuals, full-grown timber, trees in reserve, in avenues, in the borders of woods, and trees standing separate."

This right shall only be exercised, except in relation to oak designated for cutting, the diameter of which, at one meter above the ground, shall be at least 15 decimeters. (*Ib.*, 124.)

Trees standing within inclosed grounds attached to dwellings, and which are not managed in regular cuttings, shall not be subject to marking. (*Ib.*)

The one hundred and twenty-fifth article of the Forest Code regulates the formalities required from individuals, in order that the administration may be enabled to exercise the rights granted in its favor. Article 126 defines the circumstances under which individuals freely dispose of trees designated, as well as those that have not been marked.

I will not dwell upon all these arrangements deemed useful then, which have been carried into effect, and those which have ceased to operate since the 31st of July, 1837.

The marine now finds the timber which it needs in the State forests, and that which it procures at moderate prices in foreign countries, and especially from Sweden and Norway.

VIII. But there is a restriction of a permanent character which ought to be considered, for although strictly local in its operation, it is important. It relates to a public service, namely, the *Ponts et Chaussées*, and to the public works upon the Rhine.

The course of the Rhine, whose *thalweg* † forms our eastern boundary, (a line so difficult to determine,) is so irregular, and unequal, that it constantly requires new efforts to restrain it. To defend ourselves against it, we are constantly obliged, on the French bank, to resort to dikes and fascine works. The danger is continually imminent, and the remedies are therefore urgent, affecting both the public and private safety, and becoming a necessary general charge in order to retain the very soil upon which these expenses should be laid.

The Forest Code has made the following provision in regard to this case:

"In every instance in which dyke on fascine works along the Rhine shall require the prompt supply of wood or willows, the prefect shall, upon the urgency being shown, at once require their delivery from the woods belonging to the State. In case this shall not prove sufficient, these supplies may be taken from the woods belonging to communes and public establishments, and finally, if needed, from those of individuals, going for these purposes to the distance of five kilometers (9,842 feet) from the river bank." (Article 136.)

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* This was said in 1845, and in February, 1846, a proposition upon this subject was before the Chamber of Peers.

† Middle of the channel.

Here is a principle which, as you see, is a restraint upon the free enjoyment of the products of the soil—a kind of forced exportation of its productions. Now observe the means established for the execution of this right, in aid of the public service to which it relates.

"In pursuance of the rights granted in article 137, all individual proprietors of coppices or other woods on the islands or banks, or within a distance of five kilometers from the river banks, shall be required to give to the subprefect three months' notice, in advance, of the cuttings that he may propose to make. If, during this time the woods are not required, the proprietors may freely dispose of them."

But a sanction of law was necessary to guarantee the performance of the duties imposed upon individuals, and this is contained in the following article:

"ART. 138. Every proprietor who, except in case of urgency, shall make a cutting of his woods without having made the declaration prescribed by the preceding article, shall be condemned to pay a fine of one franc per *are* (119.6 square yards) of wood thus cut. A fine of four francs per *are* shall be imposed upon every proprietor who, after being notified of a requisition for his wood, shall direct its destination to any other use than that required."

It was, moreover, necessary to determine as to the manner in which the wood needed for works along the Rhine should be worked, and this is provided for in the following articles:

"ART. 139. In woods subject to the forest regulations, the workings required shall be done by the contractors for the works of the *Ponts et Chaussées*, under the direction and surveillance of the forest agents. These contractors shall, in this case, be subject to the same obligations and responsibilities as in woods belonging to the State.

"ART. 140. In private woods, the work shall be done in the same manner, and under the same responsibility, by the contractors of the public works, unless the owner shall wish to do it himself. If he does this, it should be declared as soon as he is notified of the requisition. In default by the owner of effectually doing the work within the period fixed in the requisition, it shall be done at his expense, under authorization of the prefect."

Finally, it became necessary to fix upon the formalities to be observed in agreeing upon the indemnity due to the proprietors of wood required, for the constitutional charter has decreed, "the State shall not require the sacrifice of any property for the sale of any public interest legally declared." The same article, 9, adds that "the State shall not require it without previous payment of an indemnity."

The Forest Code, a secondary law, has thus obeyed the spirit of the fundamental law:

"ART. 191. The price of woods and willows needed in the execution of article 136, shall be paid by the contractors of the works to the State, to communes, or to public establishments as well as to individuals, *within three months after the cutting is ordered*, and according to the same mode of valuation fixed by article 127 of the present law, for the timber marked by the marine."

This mode is, first, that the contractors and private owners shall mutually agree upon the terms, but the article adds:

"In case of disagreement the price shall be fixed by experts nominated upon each side, and if there is still a difference, another shall be appointed by the president of the tribunal of first resort, at the request of the most diligent party, and the expense of this valuation shall be borne mutually."

Finally, another kind of damage may result to individuals in that which relates to the workings that may be done in their woods when the cuttings are made by the contractors of works along the Rhine out of convenient season. For this case article 141 of the Forest Code adds the indemnity which may be due in this case to communes or to individuals, which may be fixed by mutual agreement or by experts. It is understood that in this case the valuation shall be made in the manner established in article 127, as already explained.

Doubless this kind of servitude laid upon French proprietors bordering upon the Rhine is an embarrassment restricted to this locality, and therefore strictly local; but it is not the less evident that it forms a very burdensome restraint upon the enjoyment of the products of the soil, and that it can only be justified by the nature and urgency of the service of public interests which it is required to satisfy.*

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*This writer also considers the principles of law as applied to sand-dunes, marshes, ponds, peat-bogs, and streams of water, and the rights of the state to order works of public utility, although it may be upon private estates.

He also discusses the various rights of using woods and forests, as embraced in the Forest Code, and the duties of the government and of individuals arising therefrom.

See also a very minute account of the Forest Code of France in *Dalloz, Dict. de Jurisprudence*, article *Forêts*, to which subject the whole of a closely printed quarto volume is devoted.

FORESTRY IN GERMANY.

In no country in Europe has systematic attention been given so long to forest culture as in some of the German states, and from none can more be learned that is really of practical utility in its application in the United States. Without attempting a sketch of the history of forestry in this part of Europe, we will proceed at once to give, a table from Captain Walker's "Reports on Forest Management," &c., showing the important statistical parts concerning the forests in six of these states and in the whole of the German empire.

States.	Extent in hectares.*	Population by last census.	Extent of forest in hectares.			Percentage of forest to total area.	Forest ar per inhabitant.
			Under State management.	Private.	Total.		
Prussia	34, 831, 924	24, 019, 567	3, 803, 388	4, 333, 965	8, 137, 353	23. 4	.339
Bavaria	7, 585, 738	4, 824, 421	1, 332, 962	1, 263, 869	2, 596, 831	34. 4	.536
Wurtemberg	1, 950, 507	1, 778, 396	309, 169	195, 933	505, 101	30. 5	.335
Baden	1, 530, 967	1, 434, 970	349, 267	161, 657	510, 924	33. 4	.356
Saxony	1, 496, 644	2, 423, 401	192, 370	280, 049	472, 419	31. 6	.195
Mecklenburg-Schwerin	1, 344, 078	560, 618	115, 321	48, 246	163, 567	12. 2	.292
German Empire	54, 102, 709	40, 089, 170	7, 247, 862	6, 692, 679	13, 940, 541	25. 7	.348

* The hectare = 2.471143 English acres.

Concerning the excellence of management of forests in Germany, the author from whom we are quoting says: "Forestry in Germany is truly a science, and differs very widely from anything I have seen called by the same name, either in India or England."

As the present occasion does not afford an opportunity to dwell upon details of management, we can only here remark that in the methods which have been molded and perfected by long experience in Germany, to meet the most exact demands of science, with the view of producing not the finest landscapes, as in many of the English forests, but the highest profits from the investment of capital, and the greatest benefits to the State, our people may reasonably expect the greatest help in forming plans to meet the growing wants for timber. As we have elsewhere repeatedly stated, we must mainly depend in the United States upon private enterprise, stimulated by the hope of gain, and enlightened by every ray that science has brought to bear upon the question of forest economy, to meet the wants before us. With this help, we may reasonably hope a successful issue. Without it, we shall have abundant reasons for unavailing regret.

With reference to that education of the popular sentiment into an appreciation of our duties in regard to forests, upon which so much with us depends, we find the following most appropriate remark by the author we have been quoting:

> "Nothing struck me more, wherever I went, than the entire absence of fencing and inclosures, considered so imperatively necessary in our Indian and English forest management. Bunches of dry grass tied to the branches of the outer trees suffice to denote forbidden ground, and to deter people from entering or driving in their cattle. And I am informed that trespass in such places is very rare and, generally, inadvertent. There is, of course, a staff of watchers, and punishment follows detection, but, considering the extensive area and comparatively small chance of detection, it must be something else which exercises a deterrent effect, and I am inclined to look for it in the knowledge *that the whole question has been thoroughly inquired into and settled; and that government or its forest-officers will not exclude man or beast, unless absolutely necessary for the good of the forests, of which all classes have learned to know and appreciate the value.*"*

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* Reports on Forest Management, p. 60.

Here is a safeguard stronger than law; and without it, law becomes a dead letter.

FORESTRY IN AUSTRIA.

The business of forestry is less advanced in Austria than in Germany. It has been recently transferred from the Ministry of Finance to that of Agriculture, now under the care of the Baron Clummecky, and Herr Tchuppitch has been employed in preparing a scheme of re-organization, designed to include all the best features of management known in Germany. Under this control, Austria will doubtless within a few years rank equally with the best of European systems in her management of this great interest, and in the beneficial results to be derived from this source of public wealth.

The state forests, notwithstanding the extensive sales which have taken place from time to time to meet state necessities, extend over an area of 1.784,037 Austrian *yochs*, equal to 2,230,046 English acres, of which 653,347 acres are classed as unproductive. The estimated yield is given as 65,838,200 cubic feet of fire-wood, timber, &c.

The budget for 1872 shows a gross income of 4,148,653 gulden, and an expenditure of 3,049,479 gulden, leaving a clear profit of upward of 1,000,000 gulden to the state. The income is classed as from sales of material, rental of lands not timbered, (very small in amount,) and miscellaneous receipts. The expenditures are *ordinary*, such as cutting, transportation, planting, repairs of buildings, collections, management, taxes and burdens for religious and educational purposes, &c., or *extraordinary*, including purchase of lands, new buildings, extra establishments, &c.

The existing establishments are not uniform throughout the empire, each of the twelve provinces or divisions having a separate organization, and differing widely in nomenclature, duties, strength, and emoluments. The Austrian Forest Academy, at Mariabrunn, near Vienna, has a course of three years, and fine museums of special interest to the forester, especially in the sections known as *Forst Betrieb*, (forest working,) and *Ingenieur's Museum*.*

FORESTRY IN SWITZERLAND.

In no country in Europe has the waste of forests been more rapid or destructive than in Switzerland, and in none, perhaps, has this improvidence been followed by more disastrous results. The woods being considered common property, were uprooted; and the soil on the mountains being exposed to the wash of the rains, was rapidly carried away, leaving broad areas of naked rock, from which the water would at once sweep down the valleys in sudden and destructive inundations. The autumn of 1868 is memorable on account of these floods.

Public attention has, however, been thoroughly awakened, and active measures are in progress to remedy, so far as may be, these evils. The cantons which have charge of these operations have for some time, at great expense, been constructing works near the head-waters of their rivers to contol the waters of these turbulent streams, and planting trees wherever practicable.

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* The former has a collection of all instruments and appliances used in working forests and getting out their products, from the most rude and primitive contrivances of former times to the perfect-working machinery of to-day. The engineering department has plans of river-beds, improved and embanked for floating, sluices of all kinds, dams and weirs for directing rafts and for catching fire-wood, which is floated in billets, models of rafts, with accurate details of construction, and all sorts of wood prepared in various ways for showing their structure, qualities and uses; also specimens showing the damages done to timber by animals and insects. These museums are a feature of forest-schools generally, and that at Neustadt-Eberswalde is in some respects quite superior.

So important has this duty become, it has been proposed that the national government shall assume its control, and a series of amendments to the constitution has been proposed having direct reference to this subject. These articles were approved by the Federal Congress in December last, and will be submitted on the 19th of April next to the people for ratification. There can be no doubt but that they will be adopted by an overwhelming majority. These amendments are as follows:

> ARTICLE XXII. The Federal Union has the right of supervising structures for the protection of water-courses, and of the forest police in the mountain regions. It will assist in the improvement and building of protective structures for water-courses, and in the planting of forests at their sources. It will enact the requisite protective regulations for maintaining these works and the forests now existing.
>
> ARTICLE XXIII. The Federal Union is authorized to enact regulations for governing fisheries and hunting, and make particular provision for the preservation of the mountain-game, and also for the protection of birds useful to land and forest culture.

A school for practical instruction in forestry has been recently established in nearly every canton, and a society named the *Schweizerischen Forstverein*, numbering some three hundred members, is usefully employed in promoting the interests of forestry throughout the nation.[*]

FORESTRY IN ITALY.

Soon after the present kingdom of Italy was established, a central forest school was organized near Florence, under the direction of A. di Bérenger, formerly in the Austrian forest service of Venezia, and author of an excellent work on the history of forest management in Italy.[†]

The school is located in the splendid silver-fir forest of Valombrosa, below the crest of the Appenines, on their western slope, about twenty miles east of Florence.[‡] In winter it is transferred to a lower station at Paterno, in the region of the olive, half-way between Valombrosa and the railway station of Pontassieve, in the valley of the Arno. A collection of excellent memoirs is being published by the director, with the assistance of some of the professors, for the use of the students.[§] It is designed to embrace a brief history of forest management in Germany, France, and Italy, and a great amount of practical information in relation to botanical and physiological subjects. Italian forest literature of direct practical application is comparatively modern, but of late the publications of the Ministry of Agriculture (to which sylviculture is intrusted) contain much that is valuable. The two most important of these are a collection of the laws and statutes referring to forests which have legal force in the different territories composing the kingdom, and a general statistical account of forest lands in Italy.*

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[*] We are indebted to Mr. John Hitz, consul-general from Switzerland, and a member of the society above named, for much of the information here given concerning forestry in his country. Much useful information concerning the forest question in Switzerland will be found in an article by Dr. Von Berg entitled *Die Forstlichen Verhältnisse der Schweiz*, published in the 18th volume of the *Tharander Forstliches Jahrbuch*, in 1868.

A valuable report was published at Berne in 1862, containing the results of a careful scientific inquiry into the condition of Alpine forests.

[†] *Archeologia Forestale, ossia dell' antica Storia e Giurisprudenza Forestale in Italai* Venice, 1863.

[‡] Besides the silver-fir forest of Valombrosa, there are many other public forests in Italy, among which may be mentioned the old forests of the Venetian republic, which in the middle ages yielded most of the timber used for the navy of that rich and powerful State. The oak forest of Montello, near Treviso, the mixed beech and silver-fir forests of Consiglio, north of Ceneda, and near Auronzo the Lommadida forest, of limited extent, but on a deep rich soil, and with an exceedingly luxuriant growth of spruce, larch, and other trees. (Dr. Brandis *in* "*Reports of Forest Management*," p. 196.)

[§] *Raccolta di memoire lette nel R. Instituto Forestale di Valombrosa.*

The amount of forests in Italy is estimated as follows:

	Hectares.	Acres.
State forests	194,000	479,374
Communal forests	2,170,000	5,362,070
Private forests	2,662,000	6,577,802
Total	5,026,000	12,419,246

The total area of the kingdom is about twenty-four and one-fourth millions of hectares, and the relative amount of wooded surface about 20.7 per cent. The large ecclesiastical estates which have of late years become public property have not been retained as state forests, but sold, and a considerable portion of the crown forest-lands and other domains of the different Italian territories have also been alienated.

On the Island of Sardinia, the question of forest-lands has not (unless very lately) been settled, and although the joint property of the state and communes, they are entered in the above estimate under the latter, and are about half a million of hectares in extent.

Projects of a general forest-law for the whole kingdom of Italy have been repeatedly submitted to the Italian parliament. The evil effects of denudation are severely felt in many parts of the country, and the aim of these proposed legislative enactments has hitherto been to guard against further mischief by determining beforehand which lands shall, in the public interest, be clothed with forest or be kept under forest, and then to place the whole of these lands under the supervision or control of the public forest-officers without distinction, whether they happen to be the property of the state or of village and other communities, or of private persons. From a report with which the Minister of Agriculture submitted a project of a general forest-law, in March, 1870, it appears that the financial exigencies of the country had rendered imperative the alienation of the greater part of the forests at the disposal of the state, and that it was only intended to retain a limited area of state forests, mainly with the view of supplying the timber required by the navy, and the forests required for this purpose the bill proposed to declare inalienable.†

FORESTRY IN RUSSIA.

In this vast empire where, as in the United States, we have been accustomed to believe the forests "interminable" and the supply of timber "inexhaustible," and where, in fact, the amount of woodland in the northern two-thirds is more than twice as great in proportion to its area as in the United States, an intelligent and energetic government has turned its attention to this subject of forestry. It has undertaken to establish by its regulations the conservative measures which with us must be—so far as relates to private property—the result of a conviction on the part of its owners that it is for their interests, or to use a phrase understood by all Americans, "*that there is* MONEY *in it.*" In fact, our hopes of success on the timber question, so far as relates to lands already sold to individuals, will mainly depend upon bringing to the knowledge of the Universal Yankee the great truth *that trees make* DOLLARS. This fact once believed and we shall have tree-planting whenever needed or possible, and to show how this may be done is an important function of the proposed commission of forestry.

***Raccolto delle Leggi Forestali*, 1866; and *Statistica Forestale*, 1870. The introductory part of the latter has been published separately in the annals of the Ministry of Agriculture.

† Captain Walker's *Reports of Forest Management, &c.*, p. 194.

The forests of Russia, not including those of Central Asia, Caucasus, and Finland, cover an area of 177,159,000 déciatines, (478,257,989 acres,) being about 40 per cent. of the area of Russia in Europe; and as to population, about 6.67 acres to an inhabitant. They are divided as to ownership as follows:

	Déciatines.*
1. Belonging to the State	110,726,000
2. Owned by mines and establishments belonging to the Crown	5,394,000
3. Crown appanages	5,487,500
4. Owned by cities, churches, monasteries, various establishments, and individuals	55,551,500

Private persons and establishments owning forests enjoy the absolute right to cut and clear off at will. The forests not embraced in the last class above mentioned are under the care of the Minister of Public Domains, who has a Director of the forest department, and the organization of the service is very complete. For the purpose of fitting young men for these duties as forest agents and agriculturists, either for the government service or upon private estates, two special schools of agriculture and forestry have been established—the Institute of Agriculture and Forestry at Saint Petersburg, and the Academy of Agriculture and forestry at Petrowski, near Moscow. The course of instruction extends through three or four years, and, to facilitate their object, they are located near forests, where every detail of practical operation can be illustrated. Besides these, there is at Lissino, a village 70 verstes from Saint Petersburg, a forest school of the second grade, the course being very practical, and extending to three years.†

We are informed, from sources not official, (and therefore we cannot claim to be correct,) that the government is taking measures for planting timber on an extensive scale, especially in the Crimea, where during the war, some twenty years ago, the forests were swept away, and the country has in corresponding degree suffered from the exposure. Thus in this peninsula, the ancient Chersonesus, memorable in the fables of classic mythology as the object of the expedition of Jason to recover the Golden Fleece, in the dim and distant ages of the past—and for the greater and more memorable expedition of three great allied powers of Europe that in our day here tried to break the power of Russia, but failed—we may yet see illustrated the most successful triumphs of applied science in covering the bleak hills and arid plains with verdure, and filling the whole of this region with agricultural wealth.

Another thought in this connection should not be forgotten. If private owners are now unrestrained as to the cutting of their timber, and are therefore free to export it to other countries of Europe where more needed, would this continue in case the Government saw danger to itself in the cutting of its forest? Would not such an event, if possible, increase the demand for American timber, and thus operate to our disadvantage as to supply of timber for our own wants?

We have no means at hand for knowing whether these suspicions have any foundation, or as to how far they might be justified. We may, however, be certain, that every country in Europe would be very apt to check a commerce that was operating against its own interests, and that it becomes a duty to our own Government to take cognizance of these chances that may affect its welfare.

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* A déciatine=10.927881349584384 ares=2.69 acres, nearly.

† From a very complete and concise account entitled *Notice sur les Forèts et leur Produits, en rapport avec la superfice totale du territoire et avec la Population.* By P. N. Werekha, Saint Petersburg, 1873.

FORESTRY IN SWEDEN.

In this country, naturally favorable for the growth of timber, the attention of government has been wisely directed to an examination of its duties with regard to forests, and in 1859 a Bureau of Forest Administration was created. Forest regulations, however, extend back to 1647, and even before that, private owners were required to plant and protect from cattle *two timber-trees for every one cut.*

In 1868 a commission was appointed, under the direction of Mr. E. V. Almquist, to inquire into the need of further legislation in relation to forests, and in December, 1870, he submitted a report with a bill, making 392 printed pages, besides numerous tables.

One clause in the reported bill is a compulsory feature, which, although less stringent, is in the spirit of enactments now in force in most of the countries of Continental Europe. The Swedish bill provided that owners of private forests should not, under a penalty of from 500 to 600 rix-dollars, cut therefrom and dispose of, for commercial purposes, trees that are less than 8.3 inches in diameter, at a distance of 16 Swedish feet from the large end, or less than 11 inches in diameter at the large end. This subject was to be considered in the Diet of 1873.[*]

SCHOOLS OF FORESTRY—GENERAL REMARKS.

While in Europe special schools have been established in nearly every country on the continent, and, as we shall attempt to show from one example selected from many, on a most comprehensive plan, there is not, within our knowledge, a college or seminary of learning in the United States where the student could find a text-book or hear a single lecture upon the subject of forestry.[†] We may not expect to see one established, nor do we deem it desirable, as a governmental measure, because, with us, forests can never be cultivated under the care of Government, as in France and Germany. The management of forest estates, like the cultivation of the land, must be left to private enterprise, which may be most effectually *instructed* and *advised*, but not *controlled* by Government.

Education in this department of applied science will doubtless be provided as the demand arises, and herein an intelligent commissioner of forestry could render great aid in the way of suggestion and information with reference to organization and management. The stores of literature and statistics which, if worthy of his trust, he would gather around him, would be of inestimable service to the cause of education, and become a repository from whence those engaged in organizing plans of instruction could derive the latest fruits of European experience, and be able to commence at that point of excellence to which they had arrived.

We would, therefore, leave this to private enterprise and the wholesome stimulus of rivalry between colleges and universities competing for the popular favor.

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[*] Report of C. C. Andrews on the *Forests and Forest-culture of Sweden* to the Department of State, 1872.

[*] We wish to do no injustice to any institution by this remark, and are well aware that "agriculture and forestry" are grouped together in the programme of duties assigned to a professor in several of our higher seminaries of learning; but we mean precisely what we say, that as to forestry considered as an applied science, we have no place in the country where it is taught in even a remote degree within the requirements of existing views of education in Europe, or up to the demands of the age. We earnestly hope that this statement may not long be true, but that, beginning abreast with the best of their kind in the Old World, we may as far outrun them in this, as we have relatively surpassed the most of them in the rapid development of our industrial resources and National wealth.

But before doing so we would casually remark, that while our wealthy benefactors of mankind are looking around them for chances to associate their fame with institutions of public utility, which shall make their fame live after them when the memory of their present wealth and all else concerning them shall have perished, they would do well to notice this opportunity in a field now entirely new and vacant, but which is destined to become one of the great subjects of the future.

We will present in full, a statement of the plan and operation of the National School of Forestry in France. An abundance of information might be given in the greatest detail concerning other schools of forestry, but this will suffice for the present occasion. It may, however, be remarked, that *Germany* is both the pioneer and the model of education in forestry, and from there have come the best educators found in the schools of this science in other countries.

The following sketch of the French school of forestry at Nancy is chiefly derived from an account written by A. Pengelly, B. A., assistant conservator of forests at Bombay.*

FRENCH SCHOOL OF FORESTRY AT NANCY.

A sketch of the course of instruction in the government school of forestry at Nancy will serve to give a general view of the state of education in this branch of the civil administration in France. It is to be noticed that this is entirely in the hands of Government, like our Naval and Military academies, and that it is designed to educate young men destined for the forest-service under the control of the Minister of Finances.

ADMISSION.

Candidates must bring a letter of authorization from the director-general of forests, which can only be obtained by those from nineteen to twenty-two years of age, without infirmities, and having a diploma of Bachelor of Letters, or attainments in classical studies to warrant such diploma. They must also have an income of 1,500 francs per annum, or a pledge from friends to provide this amount while at school, and 600 francs afterward until employed as garde général on active duty.

The examinations, upon entering, embrace arithmetic and elementary geometry complete, plain trigonometry, elementary algebra, the elements of descriptive geometry, statics and physics, especially relating to the general properties of bodies, laws of motion, gravity, equilibrium, the movement of fluids and gases, heat, electricity, the theory of vapor and hygrometry, the thermometer and barometer, and the elements of chemistry and geology. They must write grammatical exercises in French, and translate some passages from Latin, explaining their rhetorical bearings, and must write an article upon some mathematical question, and another upon some subject in natural philosophy or chemistry.

COURSE OF STUDY.

The course extends through two years. In each, the winter season is devoted entirely to lectures and study, a portion of each day being devoted to drawing, either for the purposes of surveying or the construction of bridges, saw-mills, &c. The out-door part of the course commences after Easter, and then the whole school goes out to see the forests, and to apply generally the knowledge imparted in the class and lecture-rooms. These parties are divided into sections of six or seven pupils, who work together, and are responsible only for the part assigned to them. In the triangulations, the combined results of the whole are brought out after their return to Nancy.

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* *Quarterly Journal of Science*, January 1, 1870.

The lectures may be classed under the four heads of sylviculture, applied mathematics, natural philosophy, and law; and they are carried on simultaneously, two subjects being taken on each alternate day. The sylviculture treats of climates, soils, and the different kinds of trees, giving their requirements, their natures, and the qualities of their timber. It also includes a description and discussion of the different methods which have been or are still applied to the treatment of forests, giving a general view of the whole, without details. To some of the pupils forests are an entirely new subject, and they have first to learn what a forest is and ought to be.

Under mathematics is embraced all that is essential in land-surveying, leveling, &c., the construction of houses for forest-guards, and road-making.

The course in natural history is limited to botany and vegetable physiology.

The law course is an introduction to general principles, with a short course on the code respecting the chase. Each of these four subjects has a professor and an assistant professor. The oral examinations are frequent and irregular, the more effectually to secure attention to the lectures, and relate to the subjects treated of within the last ten lectures. There is nothing to warn the student when his turn will come, or to what subject it will be directed. They are held in the afternoon study-time, and a list of those to be examined that day is posted about noon, so that a brief time for preparation is allowed. At the end of the season there is an examination of the whole course.

The studies after Easter are of a more agreeable nature. In the first year a month is spent at some place, as, for instance, at Gérardmer in the Vosges, where there are forests, parts of which are surveyed by detached parties, and after taking the angles and chaining-lines, rough plans are made to detect any grave error before leaving that part of the country, reserving the more finished plans to be executed after their return to Nancy. A road is also planned out, each section taking a part of the work. A tour is then made to see some of the principal forests of France. The parts visited are the Vosges and the Jura, affording some of the finest scenery in the country. The professors of sylviculture describe the soil, climate, and position of each forest, the treatment to which it has been subjected, and the effects of the operations performed. The students take notes, which are to aid them in writing an essay on their return to Nancy.

The professor of natural history calls attention to all geological formations on the route, and to the different plants that are found, with their relations to the different soils, and to the ravages of insects, with their habits, and preventive measures to check their injuries if known. The pupils form herbariums, and after their return arrange, label, classify, and describe the specimens collected. The vacations extend from the middle or end of August to the first of November.

In the second year the lectures are upon the same subjects, at a more advanced stage. In sylviculture they embrace the management of a forest, or the way in which it should be worked, regulating the thinnings and clearings, the age at which the wood should be cut, and the amount that can be taken yearly without injury to the forest.

In mathematics the course has reference to the different kinds of saw-mills, and a short course of triangulation with the theodolite.

In natural history a course is given in mineralogy, in geology, and in zoology, the latter more particularly relating to insects and their ravages, and to the higher animals by which they are kept in check.

The legal studies relate particularly to the French *code forestière*. As in the first year, they are accompanied by frequent examinations, with markings of excellence or defect, which determine the standing of the pupil in his class.

The travels of this year are to localities where various kinds of saw-mills are seen in operation. Drawings and measurements are made, and all the information that can be obtained concerning their construction and management is noted, including questions of cost, efficiency, and relative economy. A triangulation of some portion of the country is made, using as a base some line ascertained by the ordnance survey of France, and in which all the methods, signals, and other incidents of operation are illustrated and practiced. The practical application of management is generally made the second year in the forest of Hagueneau, in which one part consists of hard wood, as oak, hornbeam, and beech, and the other of Scotch fir. The student forms his plan for the management of a portion, say 1,500 or 2,000 acres. It is divided into parcels, alike in climate, aspect, and soil, as well as in kind and age of trees found; the amount of timber is computed, the quantity that can be cut in a given period is ascertained, and the general rules for treatment are applied. Specimens of rocks, plants, and woods are given out for determination, and their proper classification and description is required.

The discipline of the school is stringent, and the supervision very complete. With the exception of an hour every second day devoted to horsemanship, there is no attention given to athletic exercises. The graduates, upon passing the examinations, go out with the rank of garde-général of forests, with the right of vacant places of this grade. They enjoy, provisionally, the pay of adjutant garde-général, and are employed in the administration.

SAND-DUNES FIXED BY TREE-PLANTING.

Forests afford the most effectual shelter against ocean winds, and the encroachments of sand-dunes and plantations of the maritime pine have alone effected this object on some parts of the coast of France, especially in Gascony, where every other effort had failed. A writer often quoted in this report* asserts that they have prevented the two departments of Landes and Gironde from being engulfed by the sand-hills which the sea is there continually throwing up.

Viewed in profile, such a forest presents the appearance of an inclined plane, sloping down from the dense and full-grown timber to the sea-shore. The first trees, starved and stinted, torn by the gale and half buried in the sand, are scarcely able to endure the unequal contest with the winds and the damaging effects of the ocean spray. Behind these, and a little sheltered, the trees grow a little higher and stronger, and so progressively inland, until, at a certain distance, the tops of the trees appear at their normal level, and the whole forest attains its full development.

SHELTER FROM WINDS.

The forests above described effectually shelter the country behind them, and render profitable for agriculture a region that could not otherwise be cultivated.

Owing to the clearing off of forests of Cervennes during the reign of

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*Clavé.

Augustus, the valley of the Rhone was exposed to the mistral, a northwest wind, that committed such damages that its origin was ascribed to the anger of Heaven, and these poor people in their terror erected altars and offered sacrifices to appease its wrath.*

In an interesting French work upon this subject it is shown how plantations in the neighborhood of Antwerp have succeeded in regulating atmospheric conditions, and transforming barren lands into fertile fields, and it is therein insisted that this example is applicable to the department of La Manche, now exposed to these injurious winds.†

The writer here quoted says:

> An observer from the steeple of the cathedral at Antwerp would have seen only a few years ago nothing upon the opposite bank of the Escaut but a vast, desolate plain. Now he can see nothing but a forest, whose limits appear lost in the horizon. Let us enter the shades of this forest. Its trees are in regular lines, and about forty years old, and they have already corrected the atmospheric conditions that made the place they cover sterile. Though the storm may shake with violence the tree-tops, the air lower down is calm, and the sands, more meager than the plateau of la Hogue, have been transformed under this protection into fertile fields. What has been done in Flanders may be done in Normandy, and no one will pretend that like mantles of verdure may not be formed at la Hogue.
>
> As if to give the lie to the idle prejudice which opposed him, an inhabitant of Dauphiny who had become the owner of the chateau of Beaumont, toward the close of the last century, planted along the very crest of a peninsula about 50 hectares (126 acres) of woods, which stand to-day a living witness of the aptitude of the place for a growth which it had been said could never survive this exposure. The *Bois de Beaumont*, it is true, bears the marks of the combat, but the victory is not the less proved. The row of trees that receives the first shock of the north wind is low and scragged. The next is shortened, but stronger, and so they slope upward to the summit, where the vegetation of the grove is level and regular, and the timber fully developed.

On the coasts of the Baltic and the Adriatic the disastrous encroachments of the sea have been sensibly checked by these means, and it has been fully proved, wherever attempted under intelligent direction, and with due regard to circumstances and conditions, that we may always expect a valuable result.

TIMBER IN WASTE PLACES.

Viewed as an agricultural product, timber offers this distinguishing feature: it will grow in places where nothing else can be cultivated. A soil too coarse and meager for the cereals may be marvelously productive in forest growth. Ravines and slopes too steep for any other useful product are the favorite seats of timber, and wherever a crevice is found in a rocky ledge the roots of a tree will burrow and spread, taking a hold so firm as to defy the storm, and acting mechanically and chemically to disintegrate the rock and change its constituent elements into useful products.

The roadside, the river-bank, along the brook, and on the overhanging cliff, a tree may always be earning wealth to its owner, in our densest settlements, and in the waste places of our most valuable lands. In many of the States, laws have been enacted favoring the planting of trees along the highways, and a laudable emulation should be everywhere encouraged in the ornamentation of farms in this way. It is worthy of the consideration of State legislatures as to whether these plantings may not be made a requirement; or be done at the cost of the owners, it they neglect it.

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* Clavé, p. 16.

† *Les Côtes de La Manche* par M. Bande de l'Institute. *Revue des Deux Mondes*, Jan. 15, 1849.

THE ADAPTATION OF TREES TO DIFFERENT SITUATIONS.*

"When land is about to be put under wood, it is necessary to determine on the species for which the soil and climate are adapted. In respect to the soil, its qualities can only be ascertained accurately by a knowledge of its chemical and mechanical composition; but, guided by experience, intelligent, practical men are often enabled to arrive at a tolerably sound judgment by simple inspection. The importance, however, of a comprehensive knowledge of the chemical qualities of soils will be understood, when it is considered that the inorganic or mineral ingredients of wood vary with the species; and if the substances required by any particular kind of tree are not present in the soil, it is obvious that that species cannot be grown in perfection. A selection of the crop that will suit the soil is just as necessary in growing timber as in rearing agricultural produce; and when an error is committed in the one case, the loss which is sustained in consequence is immensely greater than when a similar mistake occurs in the other. Nor can rotation be altogether neglected in the rearing of wood. The same species should rarely be grown twice in succession. Scarcely any kind of land can produce two heavy crops of Scotch fir, one after the other. Cases, no doubt, are known, in which larches have been planted on land newly cleared of heavy Scotch fir wood; but they have seldom made much progress, for at least a number of years. And except with fir after fir, and larch after larch, the test is not a completely accurate one. Hard-wood, oak, ash, and elm grows luxuriantly after hard-wood only on land which is rich in the mineral matters that are capable of fully developing it. Very seldom will hard-wood succeed after firs; but firs grow well after hard wood in almost any instance. The necessity, not only for adapting the species of wood to be grown to the nature of the soil, but for observing some sort of rotation in the raising of different kinds of trees, will be seen by a reference to the following table of inorganic analyses, compiled from various reliable sources:

Forest trees.	Potash.	Soda.	Magnesia.	Lime.	Phosphoric acid.	Sulphuric acid.	Silica.	Peroxide of iron.	Chloride of sodium.	Chloride of potassium.	Analyst.
Oak wood	5.65	3.77	3.01	50.58	2.32	0.78	0.52	0.38	0.02	......	Denningen.
Oak bark*	3.50		0.80	47.50	......	0.30	1.10	......	0.03	......	Berthier.
Oak leaves	27.40		3.60	16.70	10.90	......	4.50	1.80	......	......	De Saussure.
Elm wood	21.92	13.72	7.71	47.80	3.33	1.28	3.07	1.17	......	......	Wrightson.
Elm bark	2.22	10.09	3.19	72.70	1.59	0.62	8.77	0.82	......	......	Do.
Lime-tree wood	35.80	5.23	4.15	29.93	4.85	5.30	5.26	7.97	1.49	......	Hoffman.
Lime-tree bark	16.14	4.53	8.03	60.81	4.02	0.75	2.27	1.24	2.21	......	Do.
Beech wood	11.80	2.04	8.42	47.25	3.29	1.01	1.09	0.60	0.16	......	Liebig.
Beech bark	2.00		17.10	37.50	2.70	......	9.20	0.30	......	......	Hertwig.
Horse-chestnut wood.	10.10		3.20	43.60	1.50	1.20	7.50	3.00	0.07	......	Berthier.
Birch wood	12.70		2.50	43.80	3.60	0.40	4.60	0.40	0.03	......	Do.
Poplar wood	32.60		3.30	18.30	10.10	......	3.30	1.50	......	......	De Saussure.
Poplar bark	18.80		1.00	35.10	3.20	......	4.00	1.50	......	......	Do.
Poplar leaves	28.50		1.40	21.40	4.20	......	11.50	1.50	......	......	Do.
Scotch fir wood†	2.79	15.99	19.76	31.74	1.93	3.04	3.04	3.51	1.48	1.48	Bottinger.
Scotch fir bark	1.90		2.40	38.60	7.10	......	17.30	0.60	......	......	Hertwig.
Scotch fir leaves	10.50		3.10	36.80	4.70	0.90	11.60	0.50	......	......	Do.
Larch wood‡	15.24	7.27	24.50	26.97	1.79	3.60	3.60	4.25	0.92	0.92	Bottinger.

* Oxide of manganese in ash of oak bark, 7.90 per cent.
† Oxide of manganese in ash of fir wood, 18.17 per cent.
‡ Oxide of manganese in ash of larch wood, 13.15 per cent.

"From this table it is obvious that all soils cannot be alike suitable for every kind of timber; elm and lime-tree, for instance, contain a much larger proportion of potash than oak, beech, birch, or fir woods; and it is well known to practical foresters that the former species require a finer soil than is necessary for the latter. The wood of the poplar, again, it will be observed, contains both a large percentage of potash and phosphoric acid; and we know it is only on good land that it grows luxuriantly. The large proportion of magnesia and oxide of manganese, in fir and larch woods, indicate that they can be grown on soils that are somewhat peculiar in their nature; and it is known that they succeed where more valuable kinds of timber fail. It is also evident that larch requires a fully better soil than Scotch fir, particularly in respect of the amount of potash it contains; and this completely agrees with practical experience.

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* From Morton's Resources of Estates, p. 292—296.

"The amount of ash obtained from a given quantity of wood is a very important point to consider in determining the exhausting power on the soil of different kinds of forest trees. In the various woods after mentioned, the specific gravity and proportion of ash in the one hundred parts is given, as also, the amount of organic matter which is dissipated in in the act of burning.

Woods.	Specific gravity.	Ash in 100 parts.	Organic matter.	Authority.
Oak	1.17	2.50	97.50	Berthier.
Beech	0.85	0.60	99.40	De Saussure.
Birch	....	1.00	99.00	Berthier.
Chestnut	....	3.50	96.50	De Saussure.
Lime	0.60	5.00	95.00	Berthier.
Poplar	0.38	0.80	99.20	De Saussure.
Fir	0.52	0.14	99.86	Liebig.

"From this table it will be observed that the lime gives 5 per cent. of ash; and when we consider that 38.50 per cent. of the ash consists of potash, we see how it is that this tree can only thrive on fertile soils. Knowing the chemical composition of any particular kind of timber about to be grown, the next point is to ascertain the actual quality of the soil which is to be planted, and in this way determine, as nearly as possible, whether it is in every respect suited for the intended crop. As stated a little while ago, the quality of a soil can sometimes be ascertained, with tolerable accuracy, by simple inspection on the part of an experienced practical man; but while this system might work well enough in laying out small plantations it would be despising the advantages which science is well able to confer to trust to such a guess measure in carrying out extensive planting operations. The effects of a failure, in a case of this kind, are too serious to justify the adoption of it, at best, a half measure, particularly as a very small sum will secure the necessary analyses. From an investigation into the chemical constituents of different soils, and a knowledge of the composition of various species of wood, it is possible to determine, with considerable accuracy, the particular kinds of trees the land is capable of bringing to maturity. True, this determination can only be approximative, for there are properties in soils which cannot be discovered in small samples even by an analist, but which may yet have a very important influence on the production of a crop. Yet it will at least render it possible to come to such decisions as shall, in the main, be found greatly more accurate than those arrived at by simple examination with the visual organs.

"The quality of some soils can be very accurately determined by the species and vigor of their herbage; and it is well, in every case, to use this test in conjunction with an analytical one. If we compare, as in the following table, the qualities of two or three soils, which are known to differ considerably in fertility, we will see how it is possible to turn an accurate analysis to profitable account in determining the kind of crop which should be put on a particular piece of ground.

Soils.	Silica and quartz.	Alumina.	Oxide of iron.	Oxide of manganese.	Lime.	Magnesia.	Potash.	Soda.	Phosphoric acid.	Sulphuric acid.	Chlorine.	Organic matter.	Authority.
1. Sandy soil	92.01	2.65	3.19	0.48	0.24	0.70	0.12	0.03	0.08	Trace	Trace	0.49	Sprengel.
2. Loamy soil	81.26	3.58	3.41	.....	1.28	1.12	0.80	1.50	0.38	0.09	......	2.43	Playfair.
3. Loamy soil	74.39	5.54	4.71	.....	1.39	0.75	1.71	0.68	0.14	0.10	......	6.32	Anderson.

"The first of these soils is stated by Sprengel to be poor and very ill adapted for producing clover. By a reference to its constituents, and to the table of analyses of different kinds of timber already given, it will be seen that the Scotch fir is the only species of tree that could be grown on such land. There might even be a scarcity of phosphoric acid, lime, magnesia, and soda for the fir, unless the subsoil contained an equal, if not a greater quantity of these ingredients in an available form. If this analysis fairly represented the quality of the soil over a certain surface extent, it would be little else than throwing money away to plant upon it any other kind of wood; but this opinion might be modified, to a slight extent, by the herbage indigenous to the land.

"The second soil given in the table would grow oak, larch, horse-chestnut, beech and birch, but would not be quite so suitable for elm, lime, or poplar. On the other hand, the third soil being rich in phosphoric acid and potash, in addition to other necessary ingredients, would be well adapted for the growth of any of our common forest trees—climate and drainage being satisfactory. This is one only of the many ways in which chemistry may be brought to bear directly on the productive power of a country; and of these times of 'practice with science,' the neglect of an agency so important cannot be excused on any reasonable grounds. In all cases, of course, when, determining the productive qualities of land on this principle, its mechanical composition and the available form in which the different mineral ingredients exist, both in the soil and subsoil, must be taken into account, before any accurate data can be arrived at.

"It is quite a common thing to see Scotch and spruce fir timber growing in great perfection on the outskirts of a flow-moss, when similar trees, planted at the same time on the deep plat itself, are so stunted and unhealthy as to make almost no progress at all. Now, the reason is simply this: the trees growing on the margin of the peaty deposit have, in a mixture of clay and peat, abundance both of available organic and mineral matters around their roots, while those on the pure peat are starved, in so far as inorganic food is concerned. It is in this scarcity of mineral ingredients in peat which renders it incapable, even when dry, of producing any other than poor, worthless plants; and it is only by a decomposing process, and the application of necessary foreign, and especially mineral, substances, that it can become fertile in its nature. However rich, therefore, a soil may be in one ingredient, yet, if it does not contain a fair proportion of other necessary substances, it is not in a state to grow superior crops of either wood or anything else.

"In addition to studying the adaptation of various kinds of timber to different soils, altitude, exposure, and general climatic influence must always be taken into account. Every species of tree has a certain altitude under which it will thrive, but above which, however fertile the soil, it cannot be grown. 'The different kinds of plants,' says Linnæus, 'show by their stations the perpendicular height of the earth.' Tournefort found at the foot of Mount Ararat the plants which grow in America; a little higher, those of Italy and France; above, those of Sweden; and upon the summit, those of Lapland. In M. Ramondi's investigations on the Pyrenean chain of mountains, he found the common oak growing on the plains, and on the ascending slopes, to the height of 4,800 feet; the beech between the altitudes of 1,800 and 5,400 feet; and the Scotch fir growing luxuriantly between the heights of 6,000 and 7,200 feet. In judging, however, of the elevation and habitat of certain of the rarer pines, we require to make some allowance, in their artificial state, for change of latitude. We know that to remove plants one degree from the equator is equivalent to elevating them nearly 300 feet above their original position. From this cause, any place in the vicinity of London, about 1,340 feet above sea-level, would be quite as genial in climate, other circumstances being equal, as a situation only a few feet above the sea in the neighborhood of Edinburgh."

SCIENCE APPLIED TO PRACTICAL RESULTS.—REMARKS AND DEDUCTIONS FROM THE FOREGOING.

The foregoing extract has been introduced chiefly as giving a glimpse into the philosophy of tree-culture, and to show how much we are indebted to science for success.

Nothing is more common than to hear differences of opinion expressed among agriculturists as to the profits of some grain, or the merits of some system of rotation of crops, or of the superior qualities of some fruit. In matters of tree-culture these differences are even greater, and the most opposite results are shown from like treatment of like species. Now, a tree, or a plant, is a synthetic expression of the elements of matter, which the chemist produces by his analysis in their separate form. The parts lost by burning, are those elements, chiefly carbon, oxygen, and hydrogen, which the living organism gathered from the air, and from water; the ashes, are the mineral elements derived from the soil. If the constituents of every plant or tree were known, the chemist should be able to find the soil best adapted to its wants, and this being known, every plant found thriving luxuriantly, and producing its fruit bountifully, publishes openly to every one who has eyes to see, and education to understand, the analysis of the soil in which it thrives. Much, of course, will depend upon atmospheric conditions and other modifying causes. If Biography and Chronology may be termed the two eyes of History, how much more are Chemistry and Meteorology the eyes of Agricultural and Forestal Science. With the former we must include geology, mineralogy, and other studies of inorganic qualities of the soil; and with the latter, the incidents of latitude, elevation, aspect, and all the circumstances of atmospheric condition and change.

It is reasonable to expect much benefit from a careful observation of the natural vegetation of herbage that springs luxuriantly from the soil, and from noticing the kinds of timber that thrive best with these associations. Simple chemical tests for qualitative determinations may be often prescribed with great advantage.

But the constituents of the soil change under cultivation, as do the bars in a harbor from the currents. A rotation of crops can only secure the highest yield for the longest time; and this is seen in the trees that live a century, as well as in annual crops.[*] The cause of this is pointed out by the chemist, and the economies depending upon these changes can be learned only from a study of his teachings. A mistake in field-culture may be corrected in a year, but in sylviculture the error may not be known for years, or fully felt before a century. The latter, therefore, demands a higher state of scientific knowledge, inasmuch as the error lives longer, and involves a correspondingly greater loss.

The adaptation of species and varieties to conditions favorable for full and profitable development may be aptly illustrated by an appeal to the experience of every one who has attempted to produce a great variety of fruit in one orchard. We may have selected kinds recommended by the highest authorities as the best, and in the localities where these descriptions were written they undoubtedly were so; but elsewhere it might be found that they would not succeed, while another kind would unexpectedly prove the best, and of the whole range of varieties a part only might be really worth raising and others might prove quite unprofitable. It would obviously be to the interest of the fruit-culturist to determine what he could depend upon for largest profits, and limit himself to them. The same principles apply to tree-culture generally, and the causes that determine these conditions of success should be carefully observed, to the end that we may be able to improve the advantages they offer.

This is fully understood by the scientific foresters in Europe, and it is common to find in the State forests of France and Germany not great varieties, but some one or more kinds that grow the best.[†] Wherever it is found possible, oaks, in France, are preferred, on account of their great use in ship-building and for cooperage.[‡] Yet along the sea coast the maritime pine, in others the larch, chestnut, or fir trees thrive best. In some cases a mixture of two or more kinds proves most profitable, as the beech with the silver fir. The former prevents branches forming low down on the trunk of the fir, and its roots spread nearer the surface, while those of the fir strike deep and draw their mineral aliment from a different part of the soil. From like cause the beech agrees with the oak or hornbeam. Some other peculiarities of the French forests are elsewhere noticed in this report. Let it be borne in mind that these conclusions are not founded upon empirical rules, but upon careful study and observation, and hence the success that follows.

It is the pride of modern science, to make its conclusions of use to mankind by simplifying its deductions for general use, and its boast that in whatever relates to exchange of thought, or change of place, it has enabled the active business man of to-day, to accomplish results which an antediluvian age, would not have been long enough for him to have attained without its aid.

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[*] Mr. Wisner, in his paper on the forests of Thüringia, says that a traditional belief prevails in that country to the effect that, in a period of from three hundred to four hundred years, the entire character of the woods changes; and from observation and experience in France it has been ascertained that, in that country a complete transformation of the forest growth takes place even in a shorter period. Generally speaking, it has been found from the history of forests that this tendency to change the growth is unmistakable. Where, at one time, great oaks grew and flourished, is now to be seen a growth of the scrubbiest firs; and in other places the noblest shade-trees now thrive where, in years gone by, pines alone have prospered.

This subject, involving a study of chemical principles, and a wide range of observation, is practically inexhaustible, promising the largest rewards to our national resources, and immensely profitable opportunities for turning the natural resources of our soil into materials of the highest importance for human happiness.

[†] In the woodlands of France it is common to find a much greater variety of trees than in England or Germany.

[‡] A pamphlet by Bagneris and Broillard (*Etude sur la production du Chêne*, Paris 1870) is a useful guide in the planting of oak timber.

A blessing has been pronounced upon the man who would make two blades of grass grow in place of one. How much more is this due to the man who plants a tree where nothing grew before!

If allowed to draw a parallel, we would remark in this connection that we witness these benefits of science in a commendable degree in the results of fish-culture, now gaining so strong a hold upon the public favor, and destined to result in the greatest of national blessings. The fish in many cases feeds upon organizations so minute as to be scarcely noticeable to the unaided eye, and, as for other purposes of utility to man, so far as we know, entirely useless; yet in the results they offer by means of the fish which they nourish, they become the primal origin of many millions of wealth, and afford subsistence to vast multitudes of the human race.

Early in 1861 the Marquis of Tweeddale, president of the Meteorological Society of Scotland offered eight prizes of £5 each for the best sets of approved observations, with the view of ascertaining the meteorological conditions which determine the profitable or unprofitable culture of ordinary farm-crops in Scotland. The methods of observations prescribed are highly suggestive in view of those that would be applicable to the investigation of timber-growth and the adaptation of trees to conditions. In short, the whole range of published observations of this society abounds in suggestive hints and valuable conclusions of practical use to foresters, and worthy of notice in any system that might be undertaken by the observatories of this country having in view the direct applications of meteorological science to agriculture and timber-culture.

REMARKS OF PLINY UPON THE ADAPTATION OF SPECIES TO THEIR PROPER CONDITIONS.

The principle stated in the foregoing pages has been observed from earliest times of recorded observation, and is thus presented in a quaint old translation of the Natural History of Pliny the elder, printed in 1601. (P. 478.)

> "First and foremost, as we have shewed and declared before, everything will not grow in every place indifferently; neither if they be transplanted will they live. This happeneth sometimes upon a disdaine, otherwhiles upon a peevish frowardnesse and contumacie, but oftener by occasion of imbecilitie and feeblenesse of the very things that are removed and translated may owe while the climate is against it, and envious; otherwhiles the soile is contrarie thereunto."

In speaking of the powers of acclimatization, the same authority says:

> "Certainly this is a most wonderful thing to be noted, that many times the trees for their part may be entreated to remove into a forraine countrey, and there to live; yea, and otherwhiles the ground and soile may be persuaded and brought to accord so well with plants (bee they never such strangers) that it will feed and nourish them; but unpossible is it to bring the temperature of the aire, and the climate, to condescend thereto, and bee favourable unto them. * * * Moreover there is another marvel in nature, welneere as great as that, namely, that she should so change and alter in those same places, and yet exercise her vertues and operations otherwhiles againe as if there were no change or alteration in her. She hath assigned the cedar-tree unto hote countries; and yet we set it to grow in the mountains of Lycia and Phrygia both. She hath so appointed and ordained that cold places should be hurtful and contrarie to bay trees; howbeit, there is not a tree prospereth better, nor groweth in more plentie upon the cold hill of Olympus than it."

RECENT INVESTIGATIONS UPON THE EFFECT OF FORESTS UPON CLIMATE IN GERMANY.[*]

"That the forests of a country are not only of great importance in supplying many necessary productions of ordinary life, but also serve still higher purposes in the domestic economy of nature—to the extent that within certain limits the arability, the inhabitability, and beauty of the land depend upon an appropriate area of woods—has often been declared. Indeed, this fact is now generally acknowledged, at least by all educated persons, and it forms the basis of a series of legislative measures, which have for their object the protection of the forests from destruction and misuse on the part of the ignorant for selfish purposes. But, hitherto, the exact relations between the woods and the fields have not been fixed by the certainty of figures. There has always been a lack of scientific accuracy in connection with a matter of so great importance, simply because no systematic method has been carried out by which, from actual experiment, these relations could be surely determined. The discussions, therefore, which for years past have taken place on this subject, the conflicting opinions which have been advanced in literature and in scientific bodies, have been only valuable to the extent that they served to keep alive interest in a vital question. No argument which has been made has been deemed conclusive, because there has always been a failure to base theories upon the results of scientific researches.

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[*] From the MSS. report of H. J. Wisner, United States consul at Sonneberg, to the Department of State, November, 1873. It is understood that this valuable paper will soon be published in full by the Department of State.

"To obtain this scientific foundation upon which to prosecute future investigations, the kingdom of Bavaria has taken the initiative. Since 1867, under the organization of Dr. Ebermayer, professor at the Forest Academy at Aschaffenberg, a series of meteorological observations and experiments have been made at several stations within the kingdom, which were selected as being best adapted for the object in view; and most painstaking and minute investigations have been pursued by competent and experienced observers. These interesting and very important results, which have been obtained by these six years of close inquiry, have just been made public.

"The observations have been made simultaneously at a station within the forest, and at a station corresponding thereto in all respects in the open country. The results which have been reached are as follows:

"1. That the average animal temperature of the atmosphere in the woods is somewhat below that of correspondingly situated areas which are unwooded. (About $1\frac{1}{8}$ to $1\frac{11}{16}$ of a degree Fahrenheit.)

"2. That the average annual temperature at the crowns of the trees is about $1\frac{1}{8}°$ above that which is found in dense woods at a distance of 5 feet above the surface of the ground; while in the former case the average temperature is $\frac{27}{40}°$ below that of unwooded lands at a distance of 5 feet above the surface of the ground.

"3. That the average temperature of the spring within the forest was 2.95° below that of unwooded land. This difference was less apparent among shade-trees, than where pines were the growth.

"4. That the average temperature of summer in the day-time, in thick woods, is 3.78° below that of unwooded land.

"5. That the temperature of the atmosphere within the woods, in the summer season, increased 3.94° from the ground to the tops of the trees.

"6. That the average temperature of autumn within the woods was scarcely $1\frac{1}{8}°$ below that of the open land; and

"7. That in winter this difference in temperature almost entirely disappeared.

"These briefly mentioned differences between the temperature of the atmosphere within the forest and that of unwooded lands, affect the constant current of air in the day-time. For instance, the stream of air flows from the surface of the ground within the forest toward the periphery of the woods, and thence spreads over the open fields. It afterward passes back again to the crowns of the trees, and by coming in contact with the leaves which, during the day, are colder than the atmosphere, the latter itself grows cooler and heavier, and so gradually descends from the tops of the trees to the surface of the ground.

"At night the conditions are entirely different. The thermometer now is higher in the woods than in the open lands. The Bavarian observations for the month of July show that, while at midday the temperature within the forest is 8.01° below that of the unwooded land, at night it is 4.39° higher, (18 and 29 per cent.;) in August, during the afternoon, 7.13° lower, and at night 3.71 higher, (16 and 22 per cent.) During the night, therefore, the colder and denser air of the unwooded land passes into the forest, displaces the warmer air, which rises and is cooled by contact with the leaves, and then radiates.

"The maximum and minimum temperature of the open lands is never reached in the forest. The atmospheric temperature of the woods always remains several degrees lower.

"From these data, therefore, it is evident that the thermal effects of woodland are of great moment, and that climatic alterations must result from deforestation on a large scale; that these climatic changes will consist, as a general thing, in increasing the annual temperature, and in sharpening still more the extremes of heat and cold. But these thermal effects are not alone confined to the atmosphere, but have, as well, a particular influence upon the soil. The Bavarian investigations have clearly demonstrated that the average annual temperatures at various depths beneath the surface of the ground are nearly equal; that the annual average temperature diminishes downward quite slowly and by small degrees, (at a depth of 4 feet never more than 1.12°,) but that the average annual temperature of woodland soil, at all depths, is below that of unwooded land, on an average of 3.37°.

"Further, it has been demonstrated that the temperature of the soil in the spring and summer is highest at the surface and diminishes downward. In spring the difference between the warmth of the soil at the surface and at a depth of 4 feet amounts within the forest to 5.62°. In summer these differences show 7.50° both in the wood and in the open land. But the soil of the woods in summer is 7.50° colder than that of the unwooded land, and the greatest difference has been found at a depth of 2 feet.

"In contrast to spring and summer, the temperature of the soil increases in autumn and winter, from the surface to a depth of 4 feet beneath. In autumn this advance of temperature, according to the Bavarian observations, amounted to 4.50° outside of the forest and to 3.49° within the forest; in winter, relatively 4.21° outside and 4.41° inside the woods. Wooded and unwooded lands have, therefore, in winter, to the depth of 4 feet, very nearly the same temperature; the result of which is that the influence of the woods upon the temperature of the soil is not less than that which they exert upon the temperature of the atmosphere.*

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* It cannot be supposed that trees have any vital process by which a degree of heat is maintained above the medium in which they grow. Their trunks, branches, and leaves are heated and cooled in the same manner as inorganic bodies under like conditions of exposure. But wherever evaporation or condensation is taking place, the same change occurs in them as elsewhere, and the universal law of thermal result applies. "The trunks of trees," says M. Becqueral, "only acquire their maximum temperature after sunset. In summer it occurs as late as 9 p. m., while in the air the maximum temperature occurs from 2 to 3 p. m. Changes of temperature take place very slowly in the tree, but in the air they are rapid. When the leaves are cooled by noc-

"Far more important, however, than the thermal effects upon the soil and the atmosphere are the influences inherent to the forests of a country which affect the humidity of the soil and air, the quantity of the rain-fall, and the abundance of the springs. In relation to these points the investigations of Ebermayer have produced very valuable results.

"In the first place it has been discovered, that the influence of forest-lands upon the absolute contents of moisture in the atmosphere—the evaporation pressure—cannot be proved, in spite of the fact that the air of the woods is always more humid, relatively, than the air of the open grounds. This is easily explained by the greater coolness of the former. The higher a place is situated the more marked was the relative difference observed in Bavaria between the humidity of the wooded and the unwooded country. Ebermayer assumes that the augmentation of aqueous descents, caused by a larger area of woodland, noticed at many places, is to be attributed merely to the increase of the relative moisture within the forests.

"In close connection with the relative humidity of the atmosphere of wooded and unwooded lands stands the quantity of water which has been discovered to evaporate at given points, during a given interval of time, at a certain temperature, and at a certain pressure of the atmosphere, from an open surface of water.

"The Bavarian observations have proved that in an average of one year less than 64 per cent. of water evaporates within the forest than outside of it. This fact is more remarkable, because the proportion of evaporation was nearly the same at all seasons of the year, although the temperature of the atmosphere of the forests and the open lands is so different in the winter from what it is in summer. This forces us to the conclusion that the *movement of the air*, which is very much less within the woods than outside of them, plays a far more important part in relation to evaporation than has hitherto been supposed.

"But for the abundance of water and the forming of springs in any country, the evaporation from rivers, ponds, and lakes is not so important, by any means, as the evaporation of the water of the soil.

"The amount of evaporation from one square foot (Parisian measurement) of an open surface shows, in Parisian cubic inches, as follows:

	In open land.	In the woods.
April, 1869	399	200¼
April, 1870	373	226
July, 1869	407	151
July, 1870	394	151
October, 1868	158	73
October, 1869	194	50

"There evaporated, therefore, from the water contained in the soil of wood-lands, as well as from open water-surfaces, far less than evaporated from the water of the soil of the open grounds—about 40 to 50 per cent.

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turnal radiation they recever from the trunk by radiation the heat they have lost. The temperature of the air above the trees, which have been heated by solar radiation, act on the temperature of the air, and prevent it falling as low as it would otherwise have done."—*Comptes Rendus, Séances de l'Acad. des Sciences*, May 22, 1855, tome ix, p. 1049; also *Jour. of Scottish Meteorological Soc.*, (new ser.,) i, 234.

in April, 60 per cent. in July, and 70 per cent. in October—and this decrease reaches its maximum in the hottest season. Still more glaring does this difference of exhalation appear when wood-soil, covered with leaves and pine-needles, is compared with wood-soil which is free of litter of this description.

"Under the first-mentioned conditions the evaporation from one square foot (Parisian measurement) amounted, in Paris cubic inches, to the following:

	From uncovered wood-soil.	From wood-soil covered with litter.
April, 1869	200¼	78
April, 1870	226	102
July, 1869	151	55
July, 1870	151	55
October, 1869	50	25

"In wood-soil covered by litter, when compared with the bare soil of the fields, the difference in the amount of evaporation per square foot (Parisian measurement) is shown, in cubic inches, by the following figures:

	From bare soil of the field.	From litter-covered forest-soil.
April, 1869	399	78
April, 1870	373	102
July, 1869	407	55
July, 1870	394	55
October, 1869	194	25

"From these figures, therefore, it is perfectly apparent how important are the influences of the woods of a country upon the abundance of its springs and the mellowness of its soil; and in this connection how essential are woodlands which are covered with the litter of fallen leaves, the uprooting of which effects a direct injury to cultivation.

"But it must also be borne in mind that extensive areas of wood-land materially increase the quantity of the rain. At Rohrbrunn (Spessart) 62 per cent. more rain falls than at Aschaffenburg, in its immediate neighborhood, on an average of the years 1868 to 1871. Certainly one-quarter of the gross quantity of the rain-fall was caught by the tree-tops and conveyed, by evaporation, again to the atmosphere, (average of the years 1868 to 1871 at all the meteorological stations.) But of the remaining three-quarters of the aggregate rain which fell upon the earth, there evaporated during the same interval six times less from the soil of the forest than from that of the open country; and, therefore, a much greater quantity of water is absorbed by the forest, where the leaf-litter is retained, penetrating to the deeper strata of the earth, than is held by the soil of the fields. This fact is of the utmost importance in its relation to the formation of springs to the supply of water to the rivers, and to all the numerous interests of agriculture which stand in so close connection with it.

The investigations of Ebermayer have also led to very important conclusions in regard to the amount of ozone in the atmosphere.

The air contains most ozone in situations of great altitude, where there is much humidity. In dense woods, however, the amount of ozone in the atmosphere is somewhat less than in the directly adjoining open land. The most healthy dwelling-places, therefore, are not in the midst of the forests, but at their borders.

The proportion of ozone, on an average, at the six meteorological stations in Bavaria, on the borders of the forest, relatively to that contained in the atmosphere at Aschaffenburg and Zwickau, was as follows:

In spring, as 8.20 : 6.80 : 3.20
In summer, as 7.70 : 6.20 : 3.10
In autumn, as 8.00 : 5.40 : 2.20
In winter, as 8.40 : 6.00 : 1.80

These few data satisfactorily demonstrate the general importance to which these forest meteorological stations may lay claim. A considerable increase of the number of these observations may soon be expected.

To the six stations now existing in Bavaria will shortly be added ten in Prussia, one in Mecklenburg-Schwerin, and three in Alsace-Lorraine. In Bohemia, at Promenhoff, one observatory is already in operation; also three in Switzerland, Canton-Berne. The erection of a station at Valombrosa, near Florence, in Italy, is also projected."[*]

REMARKS UPON THE PRECEDING ARTICLE.

Should the bill, recommended with this memorial, become a law, it would be highly proper for the commissioner to propose to our several observatories, usually connected with some college or university, and always managed in the interests of science, a uniform series of observations tending to show the influence of forests upon climate, or climate upon forests in their vicinity, and to endeavor to secure results that would be comparable with one another, and with these European observations. So far as rain-fall and temperature records are concerned, the weather-signal service of the War Department, now successfully established, and every year proving itself more deserving of the public confidence by the increasing accuracy of its predictions, would doubtless undertake such records in forests adjacent to their stations as should appear desirable. These records would require but trifling expense, as the observers are already under pay, and the cost of instruments would be slight.[†]

RESOLUTIONS OF THE INTERNATIONAL CONGRESS OF LAND AND FOREST CULTURE.

This association, at its session held at Vienna, September 19–25, 1873, passed a series of resolutions, addressed to the various governments of the world, and which in due form may soon be officially laid before our own. They express its views with reference to the great questions of human welfare involved in the subject of forestry, and we trust it will not be deemed an improper anticipation of their action, if we here present them:

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[*] The foregoing facts are compiled from the work of Dr. Ernst Ebermayer, professor in the Central-Forst-Lehanstalt, at Aschaffenburg, which has recently appeared. The book is entitled, "*Die physikalischen Einwirkungen des Waldes auf Luft und Boden und Seine klimatologische und hygienische Bedeutung, begründet durch die Beobachtungen den forstlich-meteorologischen stationen in Königreich Bagern.*"

[†] A rain-guage, like those furnished by the Smithsonian Institution, with scales, costs about a quarter of a dollar at wholesale. A pair of self-registering thermometers and other instruments would hardly exceed $10, for each of these stations; for special observations, which need be made only at places convenient to woodlands.

1. We recognize the fact that, in order to effectually check the continually increasing devastation of forests which is being carried on, international agreements are needed, especially in relation to the preservation and proper cultivation (for the end in view) of those forests lying at the sources and along the courses of the great rivers, since it is known that through their irrational destruction, the results are a great decrease of the volume of water, causing detriment to trade and commerce; the filling up the river's bed with sand, caving in of the banks, and inundations of agricultural lands along its course.

2. We further recognize it to be the mutual duty of all civilized lands to preserve and to cultivate all such forests as are of vital importance for the well-being—agricultural and otherwise—of the land, such as those on sandy coasts, on the sides and crowns, as well as on the steep declivities of mountains, on the sea-coasts and other exposed places, and that international principles should be laid down, to which the owners of such protecting or "guardian forests" be subject, thus to preserve the land from damage.

3. We recognize further that we have not at present a sufficient knowledge of the evils (disturbances in nature) which are caused by the devastation of the forests, and therefore that the efforts of legislators should be directed to causing exact data to be gathered relating thereto.

It may be noticed as a singular coincidence, that, at nearly the same time, the American Association for the Advancement of Science had under discussion measures tending to similar results, although not expressly designing to extend its recommendations beyond our own limits, except in the way of correspondence with other associations having similar objects in view. It is not supposed that either of these bodies derived their suggestions from the other, although the proceedings at Portland *antedate those at Vienna almost three weeks in time.*

The coincidence, however, shows the wide and general prevalence of a realizing belief that the time for action *has now come,* and that it is the duty of all governments to look well to the future, and take early and effectual measures to provide against the injuries that might soon follow a further neglect of interests in this regard.

It is gratifying to notice as another independent but highly important evidence of the conviction above stated, the following recommendation of the executive of one of the richest (and, as most persons have been accustomed to regard, best-timbered) of our States:

Extract from the message of his excellency John F. Hartranft to the General Assembly of Pennsylvania, January 7, 1874.

I specially invite your attention to an evil of considerable magnitude, which every year grows more aggravated, and in certain regions, at times, is the occasion of serious apprehension and loss. I refer to the wholesale destruction of our forests, the stripping our mountains and hills of their trees, resulting in an enormous diminution of water for mechanical and fertilizing purposes, and in great changes in the normal conditions of temperature and moisture affecting the general health, and at seasons bringing about devastating floods. These consequences, as the effects of this indiscriminate waste, are demonstrable, and a wise legislation will forecast the future, and establish such regulations as will rescue our descendants from the ills a perseverance in this practice will certainly entail upon them.

It is too obvious for remark, that the information to be expected from the inquiries of the commissioner of forestry, should that office be created, would be of inestimable service in the execution of any conservative measures which the legislature of this or any other State might adopt, as well as for the use of our citizens generally, acting in view of their own several interests.

RESERVOIRS.

There are many subjects linked in with the question of forestry that would come within the province of State legislatures to provide for. Of this class we will mention particularly that of the regulation of water for hydraulic purposes, a dependence upon which vitally affects the interests of millions of capital invested in manufactures, and which, as we have elsewhere shown, is closely related to forestry. In numerous instances private capitalists have vastly improved their hydraulic power, which would otherwise have been lost through the dry months of summer, by constructing *reservoirs* for retaining the excess of spring floods and melting winter snows, until needed for use.

Now, a general law, carefully considered, in view of the rights of all concerned, might be proposed, but has never yet been enacted, whereby those owning these rights anywhere, or a controlling majority of such, might organize an association and acquire corporate powers adequate for the attainment of this object.

Operations for the supply of water for domestic use in cities and for navigable purposes, the irrigation of farming lands, and the reclaiming of desert tracts where no cultivation can be started without water, have an obvious connection with the inquiries proposed by a commission of forestry, and would manifestly be greatly benefited by them. Not only this; they could not be safely undertaken without a knowledge of the principles to which the questions involved in forestry relate.

TEACHINGS OF OUR COLONIAL HISTORY.

A well-known writer upon our early national history mentions the restrictions placed upon the industry of the colonists, and among these, upon timber, as prominent causes of the discontent which led to the revolution:

> They forbade the use of water-falls, the erecting of machinery of looms and spindles, and the working of wood and iron; they set the King's arrow upon trees that rotted in the forest.*

In noticing the restrictions upon fishing and lumbering, the two great branches of colonial industry in Maine, he mentions as among the most burdensome, one, that which provided that all pine-trees of the diameter of twenty-four inches and more than a foot from the ground, on lands not granted to private persons, should be reserved for masts for the royal navy, and that, for cutting down any such tree without special leave, the offender should forfeit £100 sterling. "This stipulation was the source of ceaseless disquiet, and it introduced, to guard the forests from depredation, an officer called the Surveyor-General of the King's woods. Between this functionary, who enjoyed a high salary, considerable perquisites, and great power, and the lumberers, there was no love." In fact the relations between these officials and those interested in these parts in the lumber trade, were a continual source of irritation, and may justly be reckoned among the causes of alienation which led the way to our national existence.

In the early seignorial grants in Canada, we got glimpses of that wisdom of the days of Louis XIV, which, under the direction of Colbert and others, laid the formation of the science of forestry of France as embraced in and derived from the ordinance of 1669, which we have, elsewhere noticed.

In some of the colonial land-grants of New York, more than a hundred and fifty years ago, we find provisions embraced in titles, relating to precautions against fires in the woods, that even now would be received as models of excellence. Thus we get gleams from history to illustrate the subject now under consideration, not unworthy of our attention, and often full of meaning.

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* Sabine's *Loyalists of the American Revolution.*

NATIONAL RESPONSIBILITIES IN RELATION TO FORESTS.

It is not useless to remind the men of our day, with many of whom the aggrandizement of self, is the supreme law, that the world was not made for themselves alone, and that among the benefits which they enjoy without scruple, there are some which they hold in trust for the future. Of this class are the forests, which, more than any other kind of property, bind together the interests of successive generations. The hand that plants the acorn will never cut the full-grown oak that springs from its germ. We may tolerate, because we cannot control, the man whose actions betray the maxim of his life, illustrated in the motto "*post mihi diluvium.*" But with the Government, the case is far different, and we cannot *afford*, as a nation to remain indifferent spectators of these causes which are operating so effectually to our injury.

DUTIES OF THE HOUR.

These statements being shown, the duties of the occasion are obvious. The dangers are approaching more rapidly than those whose attention has not been engaged upon the subject would admit; and already the shadows of the coming event fall with certainty upon our path.

We hold this goodly heritage of country, so broad in its extent, and so rich in native resources, only in usufruct to use well while it remains in our trust, and to transmit to those who may come after us, for like enjoyment, and ever progressive improvement, till the latest period of coming time. The responsibilities of the hour admit of no postponement till a more convenient season, and the youth now in our schools and academies, who are in a few years to succeed to the places of duty and of trust which are filled by those in authority to-day, will, if these present duties are evaded, have just reason to name those now holding places of high responsibility as having in one sense brought these evils upon the country, by neglecting the only means whereby they might have been averted.

Believing that our country is capable of yielding, besides the agricultural products necessary for use, a sufficient supply of timber for all needful wants, with proper economy, for an indefinite period in the future, we cannot hope that this supply will last always, unless the economies of forestry are diligently studied, and the scientific principles upon which success depend are carefully ascertained and rigidly applied.

In beginning now, before the necessities are pressing, we may be able to provide against them before they become a grave calamity. We therefore recommend the passage of the accompanying bill, believing that if the measures which it provides are faithfully put into execution in the spirit in which they are now offered, and with that efficiency their importance demands, the investigations that may be expected to result will prove of the greatest public utility.

ON THE DUTY OF GOVERNMENTS IN THE PRESERVATION OF FORESTS.*

By Franklin B. Hough, of Lowville, N. Y.

[The following paper introduced the discussion which led to the appointment of the committee whose memorial is found on the first pages of this document. It therefore belongs in one sense to the history of this discussion, and as such it is here presented.]

The presence of stately ruins in solitary deserts, is conclusive proof that great climatic changes have taken place within the period of human history in many eastern countries, once highly cultivated and densely peopled, but now arid wastes.

Although the records of geology teach that great vicissitudes of climate, from the torrid and humid conditions of the coal period, to those of extreme cold which produced the glaciers of the drift, may have in turn occurred in the same region, we have no reason to believe that any material changes have been brought about, by astronomical or other natural causes, within the historic period. We cannot account for the changes that have occurred since these sunburnt and sterile plains, where these traces of man's first civilization are found, were clothed with a luxuriant vegetation, except by ascribing them to the improvident acts of man in destroying the trees and plants which once clothed the surface and sheltered it from the sun and the winds. As this shelter was removed the desert approached, gaining new power as its area increased, until it crept over vast regions once populous and fertile, and left only the ruins of former magnificence.

In more temperate climates the effect is less striking, yet it is sufficiently apparent everywhere and throughout our whole country, but especially in the hilly and once wooded regions of the Eastern and Northern States. In these portions of our Union the failure of springs and wells, the drying up of brooks which once supplied ample hydraulic power through the summer, and the increasing difficulties of procuring water to supply canals for navigation and wholesome water for cities, are becoming every day something more than a subject of casual remark. It is destined to become a theme of careful scientific and practical inquiry to ascertain how these growing evils may be checked and whether the lost advantages may be regained.

SOURCES OF RAIN.

We regard the ocean itself as the source whence the moisture precipitated in rains is mainly derived. Its area changes not; the exposure to solar heat is uniform, unless, as some suppose, the spots on the sun's disk may have an appreciable influence; and, except as varied within fixed limits by the inclination of the earth's axis in its revolution around the sun, there are no astronomical or other causes that should sensibly change the annual amount of general evaporation from the surface of the ocean from year to year or from age to age. The vapors raised from the sea are distributed by the winds over the land, and descend as rains where mountain ranges, forests, and other causes favor condensation. It is probable that the Gulf of Mexico furnishes more vapor for rain within the United States than the Atlantic Ocean, its influence being felt throughout and beyond the great basin of the Mississippi and its tributaries.

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* This paper was read at a public session of the American Association for the Advancement of Science, at Portland, Me., on the evening of August 21, 1873, and is printed from the Proceedings of the Association for 1873.

NO PERCEPTIBLE CHANGES IN TOTAL ANNUAL RAIN-FALL.

In a work which I recently prepared for the Regents of the University of the State of New York, I was able to collect, from all sources and for various periods, in some stations for almost half a century, about two thousand years of rain-fall records within the State of New York;* and in a volume published within the last year by the Smithsonian Institution, there is a much more extended series for the whole country.† These extensive series are not enough to determine, with any claim to accuracy, the secular changes, if any, that may be going on in the amount of precipitation of rain and snow. Although they reveal great irregularities in a series of years at any given locality, they do not justify us in supposing that, in the general average of periods, the amount is sensibly increasing or diminishing, although they do show, in some cases, greater tendencies to drought for a series of years together, and often a more unequal distribution of rain throughout the year.

FLOODS AND DROUGHT.

This growing tendency to floods and droughts can be directly ascribed to the clearing up of woodlands, by which the rains quickly find their way into the streams, often swelling them into destructive floods instead of sinking into the earth to re-appear as springs. Aside from the direct effects of shelter and shade afforded by trees, the evaporation of raindrops that fall upon the leaves, and the chemical action of the leaves themselves, have a marked influence upon the humidity and temperature of the air beneath and around them. The contrast, in a very dry season, between an open and sunburnt pasture, and one interspersed with clumps of trees, must have been noticed by every careful observer, and the actual relative profits of farms entirely without trees, and those liberally shaded, (everything else being equal,) will show, at least in grazing districts, the advantage of the latter in the value of their annual products. The fact that furniture in houses too much shaded will mould is a familiar and suggestive instance of the humid influence of trees, and the aggregate results of woodland shade may well explain the fullness of streams and springs in the forest, which dry up and disappear when it is removed.

ECONOMICAL USES OF TIMBER.

The economical value of timber, and our absolute dependence upon it for innumerable uses in manufactures and the arts, the rapidly increasing demand for it in railroad construction and the positive necessity for its use in the affairs of common life, even were its use as fuel largely supplanted by the introduction of mineral coal, are too obvious for suggestion. It is this necessity rather than considerations of climate or of water supply that has led in several countries of Europe to systems of management and regulation of national forests, as a measure of governmental policy and public economy. Such systems have been devised to a greater or less extent in Russia, Turkey, Austria, Germany, Italy, France, Denmark, and Sweden, and more recently in British India.

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* Results of a series of meteorological observations made in obedience to instructions from Regents of the University of the State of New York, from 1826 to 1850, inclusive. Albany: 1855, 4to., pp. 502. Second series of the above, embracing observations from 1850 to 1863, with records of rain-fall and other phenomena to 1871, inclusive. Albany: 1872, 4to., pp. 406.

† Tables and results of the precipitation in rain and snow, in the United States, and at some stations in the adjacent parts of North America, and in Central and South America. Collected by the Smithsonian Institution, and discussed under direction of Joseph Henry, secretary. By Charles A. Schott. Washington: 1872, 4to., pp. 176, with charts. Smithsonian Contributions to Knowledge, vol. XVIII, article 2.

FORESTS OF FRANCE.

The extent of State forests in France is about 3,130,000 acres, to which may be added 5,335,000 acres belonging to communes, corporations, hospitals, and other public establishments, making the whole extent of forest under the management of the forest administration 8,465,000 acres, or about 13,226 square miles. They are distributed widely over the country, a large proportion being in the departments of the east. Legislation in France having in view the preservation of forests, chiefly dates from the ordinance of 1669, which fixed a certain time for the cutting of forests belonging to the State. A clause was inserted by the statesman Colbert, "that in all the forests of the State oaks should not be felled unless ripe, that is, unable to prosper another thirty years." The present French forest code was established in 1827. It intrusts the care of public forests to the ministry of finance, under a director-general, assisted by two administrations, one charged with the management of forests and the sale of their products, and the other with the police of the forests, and the enforcement of forest laws. In the departments there are thirty-two conservators, each in charge of one or more departments, according to the extent of forests in each. The immediate supervision is intrusted to inspectors, who are assisted by sub-inspectors and *Gardes Généraux*, who live near, and personally superintend the work of the forest guards. The latter live in the forests, and act as police over a certain range. They personally observe the operations and report all infractions of the laws. No timber is cut till marked, and most of the saw-mills are owned by the government and rented to the wood-merchants. The system has been extended to Algeria, where several rainy days have been added to July and August by forest culture.

EUROPEAN SYSTEMS OF MANAGEMENT NOT APPLICABLE WITH US.

These details might be extended, but they would not have practical application with us, because our States, as a general rule, own no large forests, and we have no strong central organizations or means of enforcing the stringent regulations which make their system a success. The title to the lands in our older States, (where the evils resulting from the loss of forests are liable to be first and most severely felt,) has already passed into the hands of individuals, and from the theory of our system of government, the power that must regulate and remedy these evils must begin with the people, and not emanate from a central source. With us there are no great estates, entailed upon future generations, to keep together, and promising a reasonable hope of reward to the family for a heavy investment in their improvement. Nor is there even a reasonable prospect that the landed estate of a wealthy citizen will pass unimpaired and undivided beyond one generation of his descendants. It should also be remembered that, from the peculiar nature of forest-culture, one generation must plant for another to reap, as the age of a full-grown tree in some species much exceeds that of a human life. The investment for land, planting, and protection must be carried with interest into another century, and for the benefit of a generation unborn.

AMERICAN VIEWS AS TO REMEDIES.

These considerations present a problem, difficult it may be of solution, but I have confidence in the ability of our American people to work out a practical system adapted to our social organization and our general theory of laws. We must begin at the center of power, and that center is the circumference. We must make the people themselves familiar with the facts and the necessities of the case. It must come to be understood that a tree or a forest planted is an investment of capital, increasing annually in value as it grows, like money at interest, and worth at any time what it has cost, including the expense of planting and the interest which this money would have earned at the given date. The great masses of our rural population and land-owners should be inspired with correct ideas as to the importance of planting and preserving trees, and taught the profits that may be derived from planting waste spots with timber, where nothing else would grow to advantage. They should learn the increased value of farms which have the roadsides lined with avenues of trees, and should understand the worth of the shelter which belts of timber afford to fields, and the general increase of wealth and beauty which the country would realize from the united and well-directed efforts of the owners of land in thus enriching and beautifying their estates.

ENCOURAGEMENT, HOW TO BE EXTENDED.

In this great work of popular education, agricultural societies and kindred associations may do much, by promoting a spirit of emulation, and offering premiums for the most effectual results. In a recent premium list of the Highland and Agricultural Society of Scotland, I notice *fourteen* prizes offered, amounting to one hundred sovereigns, in medals and coin, for approved reports upon the subject of tree-culture in its various relations. They have also established a system of examinations, by competent professors of their univerrities, at which young men may appear and receive certificates of attainment, according to degree, which can scarcely fail to find for them profitable employment by the owners of forest estates. They afford a strong incentive to high ambition, and a conspicuous opportunity for those who seek distinction in a lucrative and honorable employment.

SCHOOLS OF FORESTRY.

The necessities of European governments have led to the establishment of schools of forestry, for instruction in the sciences that find application in the growth, preservation, and removal of timber, in which an eminently practical system of education is adopted, and the precepts of the class-room directly applied in the operations of the forest. About a dozen such schools exist in Belgium, Denmark, France, Germany, and Switzerland.* The necessity for special education in this department is sure to arise in our own country, in which perhaps fewer persons will find a special profession in forestry, but a greater number will feel the want of practical instruction in the principles upon which success depends.

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* Including private institutions and schools in which forestry is taught with other sciences, the number is much greater. In mentioning the number stated, we had reference to schools strictly under government management, as forest schools.

THE GOLDEN OPPORTUNITY.

Our educators would act wisely in taking this into consideration, in devising plans for new institutions, or revising plans of existing ones, and perhaps some far-seeing and enlightened benefactor, of sufficient means, may find in this direction the opportunity of rendering his name familiar in the annals of fame, by establishing a school of forestry, in its most comprehensive sense, for the systematic training of educators and practical engineers, in this inviting field of enterprise, and fully adapted to our American wants and ideas upon this subject.

LAWS NEEDED—METHODS SUGGESTED.

However much the public may favor, there will still arise the need of laws to regulate, promote, and protect the growth of wood; as we find laws necessary in the management of roads and bridges, or of any other great object of public utility. Let us consider some of the measures which a State might adopt for the promotion of this end, without interfering with personal rights, or stepping beyond the line which limits its duty in protecting the rights of its citizens.

1. By withholding from sale such wild and broken lands as might be returned from time to time for non-payment of taxes, when found chiefly or only valuable from the growth of timber, and by establishing laws for its protection, and for realizing to the State or to the county whatever profits there might arise from the thinning out of timber, so as to preserve the tract as a forest. In this connection I would remark, that a more effectual vigilance would probably be secured, if the benefits belonged to the local administration of the place, as party jealousies and private interests would tend to keep officials under close surveillance, where a State officer, residing at a distance, and not personally known in the locality, would often find his authority ignored, and the public interests in his charge invaded. There should, however, be required an annual report to a State officer, clothed with ample power to enforce a rigid compliance with the laws upon the subject of forests.

2. By exempting from taxation for a limited time, and by offering bounties, for lands planted and inclosed for the growth of forest-trees.

3. By offering bounties to counties, towns, and individuals, for the greatest number of trees planted in a year, and made to live through the second season.

4. By requiring railroad, turnpike and other road companies, where valid reasons to the contrary do not exist, to plant the sides of their roads with trees, or empowering town authorities, in case of neglect, to do this at their expense.

5. By imposing a tree-tax, payable in the planting of trees, or a fixed sum for each tree, to be expended only in planting trees. In cities and villages this commutation might be applied under local officers to the improvement of parks or other objects of public utility and ornament.[*]

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[*] A tree-tax is provided by an act passed by the legislature of Nebraska, which took effect March 1, 1871. It is as follows:

AN ACT to provide for the planting of shade-trees in towns, cities, and villages.

SECTION 1. *Be it enacted, &c.*, That the corporate authorities of the State of Nebraska shall cause shade-trees to be planted along the streets thereof.

6. By protecting trees on the way-side, and in public places, as well as on private grounds, from wanton destruction, by adequate penalties, sufficient to restore the loss and pay the injury.

7. By requiring the elements of science applicable to forest-culture to be taught in the public schools, and by encouraging it in academies and colleges. This, in the higher grades of schools, would embrace the most approved methods of cultivation, the influences of soil and climate, and the various mathematical, mechanical, physiological and chemical principles involved in the subject. Special schools under national or state patronage might ultimately be founded.

TREE-PLANTING ON THE PRAIRIES.

Congress has recently taken action tending to encourage the planting of forests in the Territories, where most needed, but might do much more in promoting this great measure of public utility. A few of the States have also done something intended to advance the same object, but without uniformity, and as yet with but very limited result.

RESERVOIRS.

With respect to the failure of water-supply for hydraulic power, navigation, or city use, until woodland shade can be restored to the sources, we must depend upon *reservoirs*, to retain the surplus floods of winter for summer wants. There are few streams or rivers in the country, where these might not be made to advantage, and in some cases greatly to the improvement of the natural capacity of these streams as they were first known. In the construction and maintenance of these reservoirs for navigable canals or for cities, they should obviously be under the same control as these works themselves, of which they are the essential part. But where needed for hydraulic power only, they could best be intrusted to the management of those who have an interest in them, and Government should only provide, by general laws, for the organization and regulation of companies with the corporate powers necessary for their object. As in other cases where pecuniary values are involved, the vote or power of each owner should be in just proportion to his interest, with the right of appointing a proxy to represent it when desired. Under suitable regulations of law, such associations could scarcely be perverted from their proper object.

SEC. 2. For the above purpose a tax of not less than one dollar nor more than five dollars in addition to all other taxes shall be levied upon each lot adjacent to which trees are to be planted as aforesaid, and collected as other taxes.

SEC. 3. Trees shall be annually planted, when practicable, on each side of one-fourth of the streets in each city and village in the State of Nebraska, until all shall have shade-trees along them not more than twenty feet apart.

SEC. 4. The corporate authorities aforesaid shall provide by ordinance the distance from the side of the street that trees shall be planted, and the size thereof:

SEC. 5. Provided the owner of any lot or lots may plant trees adjacent thereto where ordered as above in the manner and of size prescribed; and on making proof thereof by affidavit to the collector, said affidavit shall exempt the owner from the payment of the aforesaid tax.

SEC. 6. Any person who shall materially injure or shall destroy the shade tree or trees of another, or permit his animals to injure or destroy them, shall be liable to a fine of not less than five dollars nor more than fifty dollars for each tree thus injured or destroyed, which fine shall be collected on complaint of any person or persons before any court of proper jurisdiction. One-half of all fines thus collected shall be paid to the owner of the trees injured or destroyed; the other half shall be paid into the school-fund.

SEC. 7. That this act shall not apply to any person that is occupant of any business lot without his consent.

SEC. 8. This act shall take effect and be in force from and after its passage.

There may be cases in which a State would be justified in making reservoirs to improve the hydraulic power of rivers, thus securing solidity of construction, and amplitude of size; and often such improvements might be made before any capital had been invested along the line, or where its amount was too feeble to warrant the expenditure; but the expense should ultimately be taxed upon the interests concerned, and the management should be given up to these interests as soon as it can safely be done.

ADIRONDACK WILDERNESS OF NEW YORK.

In the State of New York, measures have been begun for the preservation of forests, which I may briefly notice. An extensive region north of the Mohawk River and west of Lake Champlain, embracing over two million acres of land, the Adirondack Mountains, and the sources of the Hudson and other rivers, lies an unbroken wilderness. More than a hundred years have passed since settlements were formed on its southern and eastern borders, and more than seventy since it has been entirely surrounded by a belt of improvement embracing some of the best farming lands of the State. Although a scheme of speculation was far advanced before the close of the colonial period, for the settlement of this region, and great sums have since been wasted by capitalists in attempting to develop its agricultural resources, these efforts have uniformly resulted in failure; and, excepting in a few favored spots, the region is still as wild and picturesque as when it was known only as the hunting-ground of the native Indian. This uniform failure may be justly ascribed to the scanty, sterile soil which covers the surface where the surface is not the naked rock, and to the cold and forbidding character of the climate, due to great elevation and the influences of mountain-ranges. Corn and the cultivated fruits would seldom ripen, from the frosts that may happen at any time in the summer, and only hay, oats, and potatoes can be grown to advantage where the soil and exposure favor. Yet it is for the most part covered with timber, often of the finest quality, and it is supposed to abound in magnetic iron ores, of which mines are wrought with great profit near the eastern border.

Some twenty years ago, some railroad speculators secured from the State a grant of a quarter of a million of acres, at five cents an acre, yet failed to build the road, or to confer the advantages promised; and since this period almost the whole of the lands in this region have passed into the hands of lumbermen and tanners, leaving at present only about forty thousand acres in the seven counties wholly or partly included in the wilderness. Most of these lands have been repeatedly returned and sold for the non payment of taxes, and if no more tax-sales are held, a large portion will doubtless in a very few years again revert to the State. Through this wilderness lines of navigation extend through lakes and along rivers, with slight portages, entirely across from the Moose and Beaver Rivers on the west, to the Saranac and Racket Rivers of the northeast. For many years it has been the favorite haunt of parties of sportsmen and those seeking relaxation from the cares of business, by a few weeks' residence in summer among the wild, picturesque scenery and healthful climate of this region. Hotels for summer residence have been built upon the banks of lakes in various places in the interior, and many guides find employment in conducting parties along these rivers and lakes, and in furnishing the supplies and assistance they may need. Roads and telegraphs have been constructed to navigable points in the interior, and every year adds to the number of visitors to this great solitude of woods and waters.

COMMISSION OF STATE PARKS.

In 1872 the legislature of New York passed an act creating a commission of State parks, and appointing certain persons therein named to examine and report upon the expediency of vesting in the State the title to the wild and timbered regions lying within Lewis, Essex, Clinton, Franklin, Saint Lawrence, Herkimer, and Hamilton Counties, and to recommend such measures as might be deemed proper relative thereto. The commission was to continue two years, and there is a probability that it will be made permanent. Already, at its suggestion, the sale of lands for non-payment of taxes has been ordered to be discontinued,* and thus the first step taken towards the accomplishment of its object. The commission will recommend no inclosed grounds, no salaried keepers, and no attempt whatever at ornamentation. There should be stringent laws and adequate penalties against spoliation of timber, or destruction from careless fires; and means of access from various places on lines of thoroughfare should be provided and maintained. In some cases short canals, with locks for passing boats, might save the labor of a difficult portage, but beyond these there is scarcely more needed for the present.

WATER-SUPPLY TO CITIES.

There are, however, important questions involving the supply of water for the State canals, the preservation or restoration of hydraulic power on the rivers, and possibly the future supply of New York City and the cities and towns along the Hudson with pure water, by an ample aqueduct from the crystal fountains of the Hudson, which may be properly considered; and a fit opportunity is given for presenting, in its strongest light, the importance of protecting forests, and of promoting the growth of trees, on account of their influence upon climate and upon the general welfare of the State.

NATIONAL IMPORTANCE OF THE SUBJECT.

These questions are not limited to a particular State, but interest the nation generally, and I would venture to suggest that this association might properly take measures for bringing to the notice of our several State governments, and Congress with respect to the Territories, the subject of protection to forests, and their cultivation, regulation, and encouragement; and that it appoint a special committee to memorialize these several legislative bodies upon this subject, and to urge its importance.

A measure of public utility thus commended to their notice by this association would doubtless receive respectful attention. Its reasons would be brought up for discussion, and the probabilities of the future, drawn from the history of the past, might be presented before the public in their true light. Such a memorial should embrace the draught of a bill, as the form of a law, which should be carefully considered in its various aspects of public interests and private rights, and as best adapted to secure the benefits desired.

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* This statement proves to have been prematurely made upon mistaken information. A bill or joint resolution to this effect was passed by one house, but not the other. There is strong reason to believe that a law will be passed at the present session (1874) for the permanent organization of a park commission.—(March, 1874.)

ON THE PRESERVATION OF FORESTS AND THE PLANTING OF TIMBER.*

By FRANKLIN B. HOUGH.

[The following paper embraces many of the facts more fully set forth in the preceding pages, and to this extent it is a repetition of them. It will be noticed that it applies more particularly to the interests of forestry in the State of New York, although not without relation to agricultural interests generally.]

When the region now included in the State of New York first became known to Europeans it was covered with a heavy growth of forests. The only exceptions were parts occupied by rocks, marsh, or river intervale, the beaver-meadows, here and there along the streams, and now and then a little patch of open ground where the native Indians tilled the soil in their rude and simple way, by the side of some favorite lake or stream, which afforded the best opportunities for subsistence by hunting and fishing.

FORMER ABUNDANCE.

This forest opposed the first resistance to the labors of civilized man, and must be cleared off before the first field could be sown or the first fruit-tree planted.

Although forest-products afforded from the beginning an important class of commodities needed in the Old World, and an abundance of conveniences of greatest use in the New, still the apparently inexhaustible supply seems to have licensed an unlimited waste. The cash receipts for potash would go far toward meeting the first payments for land, and so the work of destruction, begun with necessity, went on as if there were no hereafter, and wanton waste had made sad havoc with our timber long before it came to be realized that even its conversion into lumber for exportation, and use in the cities, was more economical than burning it to ashes on the ground.

Through the first two hundred years no other fuel was thought of anywhere in our country; and even now, except along our thoroughfares of canal and railroad traffic, wood is still the principal or only fuel. The construction of these lines of communication, while it has favored the introduction of mineral-coal, and thus reduced the demand for fire-wood, has at the same time opened channels for transportation and stimulated the demand for lumber and other forest-products in a still greater degree; so that if there is now less waste, there is a greater and rapidly-increasing consumption. If the asheries, once so numerous, have mostly disappeared, the saw-mills and tanneries have in a like ratio multiplied, and the havoc to our forests has gone on until even these have in many places exhausted the supplies around them. The soil, indeed, has been opened to cultivation; yet over extensive areas scarcely a tree has been left to shelter it from the sun and the winds. I invite your attention to some of the consequences which may be expected to follow this improvident waste, and will venture to propose some conservative measures tending to compensate for this continued exhaustion of supply.

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* This paper was read before the New York State Agricultural Society, at their annual session in the Assembly Chamber of the State capitol at Albany, N. Y., on the evening of January 21, 1874. It is reprinted from the Albany Daily Argus of January 27, 1874.

Were it not for the fact that a part of our timber and lumber has been for many years derived from Canada and the Northwestern States, the want of these essential articles would ere this have been severely felt, and, at present rates, these extra limited sources must in a few years become exhausted, and we may realize, when too late, the folly of not providing a seasonable and sufficient remedy.

RAILROADS.

We will first notice the demand for wood by railroads. According to the last report of the State engineer and surveyor, we have in this State about 6,000 miles of roads finished upon main lines and 2,000 upon branches, making for these, and for sidings and double tracks, about 11,000 miles to keep supplied with ties, to say nothing of the rapid increase from year to year. This single item demanded 26,675,000 pieces, which on the average must be renewed once in six years, requiring an annual supply of 4,445,830 pieces, or about two and a quarter million of trees. The cost of fuel on railroads was about seven and a half million of dollars. We have no statement of the number of locomotives, but, allowing half to be wood-burners, and wood at $4 to the cord, there will be required for railroad fuel alone about a million of cords of wood annually. Add to these items the amount of lumber and timber used for fences, bridges, and other structures, and we shall find that it requires not less than 50,000 acres of woodland a year to supply the demand for railroad use alone in the State of New York.

OTHER USES.

If we take into account the vast consumption for farm-fences, for fuel, and for building purposes, and the vast amount required to supply the various manufactories of wooden wares and implements, and which are steadily increasing in number and magnitude, we shall begin to realize the stern realities before us, and should stop to consider the remedies that may be applied.

INFLUENCE UPON CLIMATE.

There are also considerations of the influence of the forests upon climate, and results that have been observed to follow their destruction, which claim our careful attention. It is a matter of common observation that as our woodlands are cleared away the swamps and rills which feed the streams diminish or disappear. Mills built upon streams, which in the early settlement of the country afforded an abundant water-power throughout the year, must now stop from want of water in the summer months, or use steam-power during a part of the year. The feeders of our State canals diminish, and new sources of supply must be sought. Springs and wells fail, and the increasing population of our cities and large towns finds more and more difficulty every year in obtaining the supplies of pure and wholesome water so essential to health and happiness.

TROPICAL EXPERIENCES.

In warmer climates the effects of this cutting off of forests become still more apparent, and we will notice two or three instances in which the disasters following this improvident destruction of timber have been most sadly realized. The Danish island of Santa Cruz, in the West Indies, some twenty-five years ago was a garden of freshness, beauty, and fertility. Woods covered the hills, trees were everywhere abundant, and the rains profuse and frequent. A gentleman of my acquaintance,* who visited the island when in its greatest beauty, was induced by the memory of its loveliness to resort thither a year or two since, at a corresponding season of the year, to gratify his love of botanical study, and revel in the floral beauties which his former experience had led him to anticipate. He found a third of the island an utter desert. The short, copious showers which frequently occurred in former times had ceased, and the process of desiccation was gradually advancing, leaving a barren waste except along the shore, where a narrow belt of green marked the presence of the shrubs that flourish along the high-water mark of the sea-shore. The desolation came slowly but irresistibly. First the sugar-canes failed; then a meager pasturage was maintained for a few years; and then the desert, with its sparse and prickly vegetation of cactus and other worthless plants. Some attempt had been made to stay the impending ruin, and one planter had set out a thousand trees, but every one failed.

The island of Saint Thomas, some thirty miles distant, is somewhat similarly affected, but being more broken, it receives more rain. Fifty miles west is Porto Rico, largely covered with mountains, well supplied with forests, and abundantly watered by rains.

The island of Curaçoa was, within the memory of living persons, a garden of fertility, but now whole plantations with their once beautiful villas and terraced gardens are nothing but an arid waste; and yet sixty miles away, along the Spanish Main, the rankest vegetation covers the hills, and the burdened clouds shower down abundant blessings.

The causes of these changes are directly attributable to the cutting down of timber, and in the smaller islands of tropical seas, where irrigation is impossible, the injury may be altogether beyond the power of man to repair.

Palestine was anciently described as "a good land, a land of brooks of water, of fountains and depths that spring out of valley and hills." (Deut. viii, 7.) It was "a land that flowed with milk and honey; * * a land of hills and valleys, and that drinketh water of the rain of heaven." (Deut. xi, 9–11.) But the vegetation which these conditions imply has largely disappeared, and with it in proportional degree "the rains of heaven."†

GENERAL RESULTS OF EXPERIENCE.

These instances might be multiplied to a great extent, the experience of the world in all climates tending to establish the same great fact, that sterility and drought are the natural consequences of the destruction of forests. There may be exceptional cases in which a country exposed to warm ocean winds may receive an adequate amount of rainfall, irrespective of its woodlands or open fields, and we must admit that the normal quantity is much dependent upon distance from the sea, and the influence of mountains, and other modifying circumstances. The usual quantity of rain, for example, in our State, is about 45 inches a year at New York City, about 40 at Albany, about 38 at Buffalo, and about 32 along the Saint Lawrence.

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* James S. Merriam, of New York, a devoted botanist and careful observer.

† See a paper by M. Becquerel, Compte Rendus, lx, 136, and Journal of Scottish Meteorological Society, (new series,) i, 234.

RESTORATION OF FORESTS BRINGS RAIN.

We are equally justified in saying that the restoration of timber after it has been once cut off tends to bring back the wonted showers of sylvan times, and some instances of this will be noticed.

The celebrated philosopher, Humboldt, toward the close of the last century, visited the valley of Aragua, in Venezuela, which lies landlocked, at no great distance from the coast, but without an outlet, the drainage being into a beautiful lake at the bottom of the valley, some thirteen hundred feet above tide-level. The country around had been cleared and settled, and the inhabitants began to notice from year to year a wasting away of these waters, as if they had found some outlet. Villages on the lake-shore appeared to recede, and islands, before unknown, arose above the surface. The felling of trees which crowned the slopes and crests of the mountains was assigned as the cause of the evidently decreasing amount of rain-fall, by which, says this eminent observer, "men in all climates seem to bring upon future generations two calamities at once—a want of fuel and a scarcity of water." *

A civil war followed, in the course of which agriculture was neglected, and forest-vegetation again returned, so that a traveler twenty-five years afterward described the lake as again rising, and plantations along its banks submerged and abandoned. The streams which in times of former drought had been drained dry for the purposes of irrigation were now in full flow, the copious rains rendering irrigation no longer necessary.

UTAH.

In Utah we observe a somewhat similar result. It is well known to all present that agriculture has chiefly been maintained in that Territory by irrigation, and that the construction and maintenance of canals for bringing the mountain-streams across the plains has from the first been a subject of constant care and expense. In 1866 they had 127,798 acres under irrigation, and the amount expended during one year was $303,863.77, or about $2.73 to the acre.† All observers agree that the climate is improving under the increasing breadth of vegetation which this system of cultivation has created. Much less water is needed than formerly to produce a given effect, the rain-fall is increasing, and the waters of the Great Salt Lake stand about twelve feet above the old high-water marks, and are still rising.‡ The industrious Mormons have a right to expect that, as the breadth of cultivation extends, the rains will increase in the same ratio; that the air will become more humid as trees are planted, and that a self-sustaining amount of rain-fall may in time be obtained.

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* Humboldt, v, 173.

† Of this $136,610.85 was on canals, $27,702.27 on dams, $66,696,57 on cleaning out and repairs, and $72,852.75 on private canals. (*Report Deseret Agricultural and Manufacturing Society*, 1867, p. 2.)

‡ Editorial correspondence of Country Gentleman, November 27, 1873.

HOPEFUL PROMISE TO THE FUTURE.

These results afford a hopeful promise to the treeless regions of the other Territories, where nothing but water is required to bring fertility to the soil, and, with the vegetation which this invites, a humid atmosphere and showers of rain.

The Hon. Paul A. Chadbourne, president of Williams College, in an address before the Massachusetts Board of Agriculture, published in their report of 1871-'72, (p. 61-69,) says that Salt Lake contains nearly or quite twice as much water as it did when the Mormons came, and that it has risen at least one foot a year for the last ten years:

> But it is not in Salt Lake Valley alone, or immediately around the lake, but in all the valleys around there, and throughout that Territory, that the water is increasing in quantity. Captain Stover, who went from the State of Maine, told me that ten years ago he cut grass on the borders of Stockton Lake, where now the water is forty feet deep. * * When you pass up and down throughout the Territory, as I have done this summer, you will find evidence that in all the streams the amount of water is constantly increasing, and that the Mormons regard it as a direct interposition of God.

In speaking of this change, Mr. Chadbourne was informed by Brigham Young that twelve years before they had planted a settlement where, by careful measurement, there was found water for only twelve families. Now there is a population of fifteen hundred souls at that place and an abundance of water for all. There is now much less timber on the mountains and in the cañons than formerly. But the evaporation has been greatly checked by cultivation and by groves of young trees. This writer does not think that more rains fall now than formerly, but that evaporation is less, and the general humidity much greater, thus checking the influence of drying winds.

DEWS.

The influence of forests upon the dews is important, and depends upon the greater humidity and coolness imparted to the air around them, and to the shelter from the winds which they furnish. In the immediate shade of a tree, the radiation from the earth may be in part returned, and may be less deposited; but a little farther off, the humid influence of a grove is decidedly observed. To this may perhaps be ascribed the freshness of pastures interspersed with clumps of trees, at a time when a naked pasture will be parched and brown.*

MALARIA.

We should not forget to mention the relation existing between malaria and growing trees. Fortunately in our State, diseases occasioned by malarious exhalations have, in a great degree, disappeared from the central and western portions, since the decaying mold and rotten wood exposed to the air in the new clearings have become thoroughly decomposed. But in warmer climates, where rank vegetation is allowed to decay in wet places, this poisonous element acquires its greatest virulence.

PONTINE MARSHES.

Such are the Pontine Marshes near the city of Rome, where an overflow from obstructions in the Tiber, and neglect of agriculture, has brought on an insalubrity throughout a once healthy and fertile region, which ages of patient industry can scarcely redeem. It has been found, that next after the drainage of the spongy morass, which a luxuriant and neglected growth of herbage had occasioned, the planting of trees in belts and groves affords the best means of absorbing the poison, and preventing its dispersion by the winds. The cutting down of a forest, which for ages had covered the slopes of a hill between the city and the marshes, let in the malaria upon a part of the city where it was before unknown.

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* In India dew is deposited near rivulets when all around is perfectly dry. The limit of deposition was but fifteen or twenty feet.—(*Colonel Sykes, in Transactions of Royal Society*, 1850, p. 354.)

THE EUCALYPTUS, OR BLUE GUM.

The *Eucalyptus*, an Australian tree of most vigorous growth in warm countries, has been of late especially noticed as capable of absorbing the poisonous exhalations of marshes. A recent writer* gives many instances of its successful treatment of malaria. It is asserted that this tree will absorb from the earth ten times its weight of water daily, giving off with the renovated emanations of its foliage a camphorated aroma, alike antiseptic and agreeable.

Somewhat similar properties are claimed for the long-leaved pine and other trees, as well as for the sunflower, planted in belts along the border of marshes. Wherever intermittent fevers appear to be occasioned by marshes, the planting of trees along the margin of the wet lands, so as to break the winds passing over them, would, in all probability, be followed by a decided abatement, if not a complete suppression of the evil. It is to be remembered that prevailing sickness from malaria seldom appears in our climate so long as the country is timbered, but only as decaying vegetable matter is exposed to the sun.

ELECTRICAL CONDITIONS.

It is quite probable that electrical conditions dependent upon vegetation may have a decided influence upon the precipitation of rain. We know that a hispid plant, insulated and heavily charged with electricity, quickly loses its charge, and that every point of a leaf or plant is an agency for receiving or passing off an electrical current. The telegraph-wire is robbed of its message in passing through a tree-top, if contact with the foliage is allowed; and I have no doubt but that a house surrounded by high trees is better guarded against lightning than if protected by a patent lightning-rod of average construction.

There is scarcely a change of condition or of place in nature, in which electrical phenomena may not be noticed, when carefully observed. The passage of water into vapor, its condensation into rain, the friction of the winds, a change from heat to cold, or from cold to heat, combustion and slow decay, are all attended by electrical phenomena. In its ordinary conditions the air is positively electrified, but in fogs, rain, and snow, and sometimes in cloudy weather, it is negative. The conditions change with the hours of the day and the season of the year. The facility with which electricity passes from points or is received by them, suggests the probability that forest-vegetation must have a marked influence upon these conditions and changes.

INSECTIVOROUS BIRDS.

I should not omit to notice the benefit of coppices and belts of woodland scattered among cultivated fields, for the shelter they afford to insectivorous birds. A very large proportion of our common song-birds live upon insects injurious to the farmer, and when sheltered and protected they become his efficient helpers in saving from harm the harvest of his fields, working free of charges and boarding themselves.

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* In the Monthly Report of Department of Agriculture, December, 1873.

At a land and forest congress held at Vienna during the past summer, at which some three hundred delegates from nearly every civilized country were present, the importance of birds to the agriculturist was earnestly discussed, and a series of resolutions offered tending to protect and encourage them, by asking from all governments prohibitions and penalties against their injury or destruction.. These useful allies of the field should be alike protected by stringent game-laws and by a generous and appreciating public sentiment, favoring abundant opportunities for nesting in groves suited to their habits, and secure from harm.

Some, like the robin, make their homes in the orchard, and in the trees around our dwellings; but many more, of great utility, love the seclusion of groves apart from human habitations, and we lose their services where these shelters do not exist.

RAIN-FALL RECORDS IN THE STATE OF NEW YORK.

The records of rain-fall kept at various stations in this State and the United States, do not justify us in believing that any considerable amount of change has occurred in the total amount from year to year, although the distribution of rain and snow among the seasons is in many cases more irregular, as the country becomes older, and the woodlands less. Seasons of unusual drought may succeed each other for several years together, and disastrous floods appear to be of more frequent occurrence now than formerly.

SOURCE OF RAINS.

The great source of supply of aqueous vapor, which forms rain, is from the sea itself. The evaporation from its surface is constant, and over broad areas, under a tropical sun, the amount raised as vapor and borne landward by the winds is immense, and may be regarded as nearly uniform from year to year. If the surface were all water, we may readily believe that the changes of weather would follow in strictly regular succession, like day and night, and like winter and summer. But as a part of the surface is land, and of very unequal contour, we find the vicissitudes of the weather continually changing, from causes not yet fully understood. In some regions rains are altogether unknown; in others, they are profuse, and in others scanty or abundant, as the causes which influence their precipitations are changed by the operations of nature, or through the agency of man.

AQUEOUS VAPORS.

Aqueous vapor is always present in our atmosphere, and when rain is most needed it is often in quantities sufficient for every want, if the temperature from any cause could be sufficiently reduced. This vapor is not usually perceptible to the senses, being held in suspension by the air. The capacity for absorbing vapor increases with the temperature, so that at the freezing-point, the air can support but a one hundred and sixtieth part of its weight of vapor, while at 86° it can hold a fortieth part, and at 113° a twentieth part. If from the common air, under a glass receiver, we exhaust a part, the remainder will expand to fill the whole space, and in so doing cools, and its capacity for holding vapor in suspension diminishes, until it may reach the point of saturation, and a dew will begin to form on the inner side of the glass, the air within being obscured by fog. The temperature at which this dew begins to appear is called the *dew-point*, and to this degree must the air be always reduced before clouds and rain can be formed. In meteorological observations, the absolute and relative humidity are usually determined from a pair of thermometers, one covered with muslin and moistened with water. This instrument, when wet, presently falls to a stationary degree, which is the dew-point. The differences of reading with the aid of tables, readily afford the means of knowing the *absolute humidity* or total amount of vapor in the air, or its elastic force, represented by the height of a column of mercury which this force would support, and the *relative humidity* or ratio of the quantity of vapor present, expressed in decimals, absolute degrees being zero, and saturation 1.00.

PSYCHROMETRICAL RECORDS.

There have not hitherto been taken within our State any continued series of these psychrometrical observations through many years of time. But to illustrate the subject, I have prepared from the records of the Toronto Magnetic and Meteorological Observatory, which have been kept with great accuracy under uniform rules, for over twenty years, some tables which give results quite similar to those we might expect in our State. The first of these exhibits the mean monthly elastic force of the vapor, and the second the mean monthly humidity:

I.—*Mean elasticity of aqueous vapor at Toronto Observatory.*

(The numbers show the height of a mercurial column in inches which the elastic force of vapor would support.)

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual mean.
1854	.122	.110	.156	.207	.288	.434	.550	.478	.430	.287	.180	.109	.279
1855	.125	.088	.132	.208	.258	.406	.530	.444	.406	.247	.190	.123	.263
1856	.080	.080	.090	.203	.259	.432	.489	.419	.351	.231	.179	.110	.244
1857	.083	.147	.124	.156	.254	.353	.520	.467	.393	.243	.157	.140	.254
1858	.134	.080	.119	.176	.239	.465	.481	.478	.384	.256	.162	.128	.259
1859	.126	.117	.168	.154	.298	.355	.471	.463	.337	.214	.190	.090	.249
1860	.110	.118	.148	.165	.338	.414	.427	.463	.342	.272	.195	.115	.260
1861	.102	.130	.127	.199	.238	.377	.467	.495	.400	.292	.178	.151	.262
1862	.103	.107	.132	.164	.253	.346	.473	.510	.418	.300	.171	.142	.262
1863	.140	.110	.116	.181	.299	.373	.535	.506	.350	.260	.198	.129	.265
1864	.110	.119	.135	.194	.333	.380	.473	.516	.347	.248	.182	.121	.263
1865	.086	.105	.159	.203	.278	.432	.402	.434	.458	.240	.186	.129	.259
1866	.101	.108	.124	.195	.212	.381	.535	.390	.349	.272	.192	.118	.248
1867	.086	.132	.116	.181	.233	.420	.458	.475	.360	.272	.173	.101	.252
1868	.092	.086	.140	.170	.299	.422	.619	.463	.375	.216	.175	.105	.264
1869	.127	.114	.105	.173	.258	.307	.470	.458	.430	.221	.160	.138	.252
1870	.115	.099	.186	.198	.282	.485	.523	.488	.442	.295	.175	.129	.279
1871	.110	.109	.154	.194	.283	.382	.422	.458	.317	.250	.136	.094	.242
1872	.103	.094	.088	.169	.260	.436	.507	.539	.406	.240	.152	.191	.259
Mean	.108	.107	.129	.186	.272	.403	.490	.459	.384	.256	.175	.125	.259
Highest	.134	.147	.159	.208	.338	.485	.619	.539	.458	.300	.198	.149	.279
Lowest	.080	.080	.088	.156	.212	.346	.402	.390	.317	.214	.136	.094	.242

II.—*Mean humidity of atmosphere at Toronto Observatory.*

(The numbers show the relative amount of moisture, .00 being complete dryness and 1.00 saturation.)

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Mean of year.
1853													.79
1854	.84	.86	.85	.80	.74	.74	.71	.72	.79	.80	.80	.80	.79
1855	.82	.80	.81	.75	.65	.78	.79	.74	.79	.76	.74	.77	.77
1856	.78	.76	.74	.75	.71	.79	.69	.73	.75	.75	.78	.82	.75
1857	.89	.84	.77	.74	.74	.77	.78	.77	.78	.78	.77	.80	.79
1858	.78	.77	.69	.66	.69	.69	.70	.70	.74	.72	.79	.81	.73
1859	.81	.79	.75	.63	.67	.69	.70	.70	.75	.72	.78	.87	.74
1860	.81	.81	.71	.74	.76	.71	.72	.76	.74	.81	.80	.84	.77
1861	.88	.84	.80	.73	.69	.69	.72	.78	.79	.82	.79	.79	.78
1862	.81	.84	.82	.73	.65	.66	.73	.74	.80	.82	.80	.83	.77
1863	.85	.83	.78	.68	.69	.71	.78	.76	.75	.80	.80	.83	.77
1864	.82	.82	.80	.75	.75	.63	.66	.73	.75	.80	.78	.82	.76
1865	.81	.83	.79	.72	.69	.70	.65	.69	.75	.77	.77	.79	.75
1866	.83	.81	.77	.65	.62	.72	.72	.73	.78	.75	.80	.79	.75
1867	.82	.81	.78	.73	.72	.71	.66	.68	.73	.73	.75	.77	.74
1868	.82	.81	.74	.71	.75	.74	.69	.70	.77	.77	.81	.83	.76
1869	.80	.80	.78	.68	.67	.74	.77	.76	.79	.78	.84	.83	.77
1870	.82	.80	.78	.67	.63	.72	.74	.72	.79	.79	.79	.82	.76
1871	.84	.77	.76	.69	.63	.69	.72	.68	.71	.72	.76	.80	.73
1872	.80	.79	.75	.67	.72	.73	.60	.74	.78	.77	.76	.82	.75
Highest	.89	.84	.85	.80	.76	.79	.79	.78	.80	.82	.84	.87	.79
Lowest	.78	.76	.69	.63	.62	.63	.60	.68	.71	.72	.74	.77	.73
Mean	.82	.81	.77	.71	.69	.72	.71	.73	.76	.77	.78	.81	.76

EQUALIZING INFLUENCES OF THE FOREST UPON TEMPERATURE.

In woodlands the soil is sheltered from the sun, and is usually covered by a cushion of decaying leaves. This tends to equalize the temperature, making it warmer in winter and cooler in summer than in open fields. Being cooler in summer, it requires less change of temperature to bring the atmosphere to the dew point, and hence the influence of woodlands upon rains. Besides this, when in foliage the evaporation from the leaves due to the vital action of the trees, and the drying off of water from dews and rain, afford a direct cooling process, from the well-known law of nature that nothing can pass from a denser to a rarer form without losing heat.

SHELTER.

Being sheltered from the winds, the snows lie uniformly upon the ground in a forest, and wasting away more slowly, they tend to cool the air around them, and thus prevent the injury that very warm days in early spring might otherwise cause to fruit. This retarding of vegetation in spring is similar in its effects to that from large bodies of water, on the leeward side of which, as is well known, the best fruit-districts in the country are found.

Besides these effects, woodlands shade the sources of rills, and are a screen against drying winds. In fact, such is the amount of moisture exhaled from a forest in full leaf that a dry wind could not pass over a woodland of considerable extent without acquiring a degree of humidity favorable to the cultivated lands beyond.

EFFECT OF RAIN UPON WOODLANDS.

We must probably admit that less rain in a shower reaches the earth in a forest than in an open field, since much of it is intercepted by the leaves, and in warm weather soon evaporated. But such as does reach the earth, being in a damp and sheltered place, does not run quickly off, gullying the hillsides and washing the soil into the streams, as in an open country, and inundating the valleys by sudden freshets. It sinks into the earth to reappear as springs, or is appropriated by the tender and juicy vegetation of the undergrowth, and the spongy and luxuriant growth of the swamps. The soil being more pervious to the water, in fact, absorbs much more than the sun-baked surface of clay in an open field, and hence we never hear of the drying up of streams until the country is cleared of its forests.

FACTS SHOWN BY RAIN-GAUGES AT DIFFERENT ELEVATIONS.

In ordinary conditions a rain-gauge on the ground receives more rain than on a house top, and the latter more than one placed on a lofty tower. This can only be explained by admitting that rain-drops increase in volume as they fall through an atmosphere saturated with vapor. Yet nothing is more common than a fall of rain on hilly woodlands, while "all signs fail" on the open plains below, and the rainless clouds pass over—showing to the anxious observer abundant streaks and filaments of falling rain from their under surface, which dry up and dissolve in air long before reaching the parched and needy soil.

"WHAT SHALL WE DO TO BE SAVED?"

Such being the consequences of an improvident and indiscriminate clearing off of the timber, the inquiry naturally arises: "What shall we do to be saved?" The answer is plain and obvious: "Plant trees."

A considerable area of the soil must, of course, be opened for cultivation, but there are many places where nothing but trees can grow to advantage, and many more where timber would yield a larger profit than any other crop, and with far less expense of labor, regarding only the value of the wood grown, without reference to the ameliorating influences of woodland upon the adjacent fields. If our hill-tops, steep hill-sides, ravines, road-sides, and waste places were planted with timber adapted to the circumstances of the place; if our existing timber-lands were spared by taking out only the trees of mature growth, and by protecting the young trees; and if worn-out and exhausted lands were sown and planted with trees and fenced against cattle, we might as reasonably expect a return of profits from the investment, as when we sow grain in seed-time, in soil properly prepared.

MONEY WELL INVESTED.

The return may be slower, and one generation may plant for the benefit of the next, yet the growth would in most cases be worth more than the interest of the money invested, and the value of the timber-crop at any stage of its growth, like the interest on a bond, at any time after its date, could be readily determined.

GOVERNMENTAL FORESTS.

In some European countries, vast forests are kept up by government. In England, in 1871, about 40,000 acres were planted in oak for the wants of the navy a hundred years hence, and more is being done every year to guard against coming wants. Upon the continent we find over two dozen schools of forestry, where special instruction is imparted to the youth who are to take the future care of the public forests, and private plantations. The graduates of these schools go to their duties thoroughly instructed in every detail of forest management; are able to compute the present worth of a given piece of timber-land, its rate of increase in value, the amount that may be taken annually without permanent injury to the forest, and the various scientific details upon which success in management depends.

LACK OF SCIENTIFIC KNOWLEDGE IN RELATION TO FORESTRY.

I am not aware that in the United States, attention has hitherto been more than incidentally given in any college to the applications of science to forest-culture, or that the student can anywhere in this State listen to a single lecture upon this exceedingly practical subject, in the whole course of his studies. Lands owned by the Government may be reserved, or sold subject to conditions, as the future interests of the nation may indicate to be wise and proper. Whatever is done in this way must come within the jurisdiction of Congress and of States that own lands. The State of New York has already parted with most of these titles.

PLANTING MUST BE DONE BY LAND-OWNERS.

As for the planting of timber upon lands already sold, this must begin with the owners, who, under our tenures, are the sole judges of how these lands shall be cultivated and what crops they shall produce. The profits of tree-culture must be widely taught and thoroughly believed. Our State and local agricultural societies should, in every way possible, disseminate correct information upon the subject, and encourage emulation by premiums for greatest amount of tree-planting and best methods management. A young grove should be looked upon by its owner with pride, and the tree as a thing of beauty and of promise, to be cared for and cherished both for present ornament and future use.

SUGGESTIONS FOR STATE LEGISLATION.

I will venture to notice some of the benefits which it may be within the power of our State government to confer upon the future in the care of timber-lands. A considerable amount of waste-land exists in various parts of the State, and especially in the great northern wilderness, and much of this is returned annually to the comptroller for non-payment of taxes. Should the proposed State park find favor with the legislature, as I earnestly hope it will, to this extent it will secure the preservation of our timber-lands. But there are also other tracts of waste-land in various parts of the State of little or no value except for the timber that may grow upon them. As a general rule, it may be taken for granted that where the owners allow wild lands to be sold and do not redeem them, such lands are worth nothing for cultivation. They may have been already stripped of their timber, which was all the worth they had, and will not be again desirable until a new growth of trees springs up. Would it not be best to reserve these lands, and hold them as the property of the State, instead of selling for the paltry prices they would bring at a tax-sale? Their immediate care and protection against trespasses might be intrusted to the town authorities where located, and their condition reported annually at town-meetings and to some central State office. The sale of timber and other details might be so arranged as to secure the benefits at a reasonable expense, and doubtless with as much profit as is now derived from time to time by their sale.

STATE ENCOURAGEMENT.

The State may exercise its power in other ways, as has been done to some extent in other States, by exempting, for a limited time, from taxation lands planted and inclosed for timber-growth. This feature appears in the law passed in Maine in 1872, which provides that owners planting any amount of land from which the forest has been entirely cut away, and cultivating for three years, the trees being not less than 2,000 to the acre and well distributed, may, upon application to the assessors, and upon filing a map and description of the location, and all the facts in relation to the growth and cultivation of his grove, or incipient forest, be exempted from taxes on such land for twenty years, if kept alive and in thriving condition during that time.

ARBOR DAY IN NEBRASKA.

In Nebraska the 10th of April is set apart by law as Arbor Day—an agricultural festival devoted to the planting of trees. Its State Agricultural Society has offered a premium of $100 to the Farmers' Society of the country, and $25 to the individual planting the greatest number of trees on that day.*

DUTY OF THE STATE.

A State owes it as a duty to its citizens that the public interest shall be protected at the public cost, and on this principle it causes roads and bridges to be made and maintained by assessments often payable in labor, and always chargeable upon those supposed to derive the greatest benefit from their use. In like manner might it justly charge a tree-tax, payable in the planting of trees by the owners of farming-lands, or the commutation of this tax if paid in money, to be applied to this object, along the public highways.

ECONOMY IN FENCING.

Necessity will, within a few years, teach our farmers the important fact, that a large part of our fencing might be saved, if they would confine their stock *within* the range allowed for pasturage, instead of keeping them *out* of the places where they are not wanted; much that is essential may be made of stone walls and live hedges instead of wood.

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*This statement was made from authority of an agricultural journal, and proves to be erroneous, so far as relates to the appointment of this day by *law*. We are informed that the day was appointed by the Board of Agriculture.

In the list of premiums offered for tree-planting in April, 1873, the premium was $20 for the greatest number (not less than 1,000) of hard-wood forest-trees planted, and living one year after. The Board further provided that the planting might be done on any one day in April, and might include forest, fruit, evergreen, and all varieties of trees. For the greatest number of cuttings planted on Arbor Day $25, and for the next greatest $10, were offered. Statements in relation to planting on Arbor Day were to be made under oath, with the attestation of two disinterested witnesses. Nursery-planting was not allowed to compete for these premiums.

OTHER ECONOMIES.

With the introduction of other materials for building in many cases, and the increased use of coal and peat as fuel, it may be within our means to produce within the State a sufficient growth of wood to supply our wants till the latest period of time. But to secure this provision public sentiment among our farming population must be strongly aroused, and the sooner the necessities of the case are understood and acted upon, the easier will be the remedy and the greater the benefit. It will be easier to meet the difficulty half-way, by anticipating the necessity, than to be driven to find a remedy when the want becomes an imperative demand.

FORESTRY IN MASSACHUSETTS.

It is doubtless known to most present, that more than thirty years since, the subject of tree-culture was embraced in a survey of the zoological and botanical resources of the State of Massachusetts, and that in 1846 an able and careful report upon the native trees and shrubs of that State was made by Mr. George B. Emerson. An arboratum for the naturalization of foreign trees in that State is now being formed, and not only there, but in other States, especially in the West, attention has been prominently directed to this subject.

SOCIETIES OF FORESTRY.

In Europe, field and forest culture divides the attention of societies formed for the advancement of agriculture in its broadest sense, and as an example I may notice that in 1872, the Highland and Agricultural Society of Scotland offered not less than fifteen premiums for essays and successful results upon special subjects of foresting.

RECOMMENDATIONS TO STATE AGRICULTURAL SOCIETY.

Permit me in conclusion to express the hope that this society will take early and effectual measures to promote this object, by disseminating correct information, promoting discussion, and rewarding successful culture, and that ere long we may see local societies emulating each other in the extent and value of timber planted in the districts embraced within their borders, until there shall be no waste spot without its trees, and no farm without sufficient shelter of woodland shade.

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